6644-39 DP-1007

AEC RESEARCH AND DEVELOPMENT REPORT

A COMPUTER PROGRAM FOR THE OPTIMIZATION OF ORGANIC-COOLED D_2O REACTORS

J. W. Wade

RECORD ONOT RELEASE FROM FILE



Savannah River Laboratory

Aiken, South Carolina

LEGAL NOTICE

This report was prepared as an account of Government sponsored work. Neither the United States, nor the Commission, nor any person acting on behalf of the Commission:

A. Makes any warranty or representation, expressed or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or

B. Assumes any liabilities with respect to the use of, or for damages resulting from the

use of any information, apparatus, method, or process disclosed in this report.

As used in the above, "person acting on behalf of the Commission" includes any employee or contractor of the Commission, or employee of such contractor, to the extent that such employee or contractor of the Commission, or employee of such contractor prepares, disseminates, or provides access to, any information pursuant to his employment or contract with the Commission, or his employment with such contractor.

Printed in USA. Price \$6.00 Available from the Clearinghouse for Federal Scientific and Technical Information, National Bureau of Standards, U. S. Department of Commerce, Springfield, Va. 22151

664439

DP-1007

Reactor Technology (TID-4500)

A COMPUTER PROGRAM FOR THE OPTIMIZATION OF ORGANIC-COOLED D₂O REACTORS

by

James W. Wade

April 1966

E. I. DU PONT DE NEMOURS & COMPANY SAVANNAH RIVER LABORATORY AIKEN, SOUTH CAROLINA

CONTRACT AT(07-2)-1 WITH THE
UNITED STATES ATOMIC ENERGY COMMISSION

ABSTRACT

The portion of the Cost Optimization Program, COP, that is used to design and calculate costs for organic-cooled, heavywater-moderated power reactor plants is coded in FORTRAN II for an IBM 704 computer. The code is applicable for power reactor plants with electrical outputs of 300, 500, or 1000 MWe. The main features of the code include: (1) an automatic design of concentric fuel tubes of either UO2 or UC including the calculation of the operating conditions of the fuel assembly and a determination of the reactivity parameters $f\phi r$ a unit cell, (2) the determination of the number of fuel positions and an estimate of the fuel life for several fuel charging strategies, (3) an evaluation of the fuel fabrication costs for the specific fuel assembly design and reactor throughput, |(4) the design and cost determination for the major reactor equipment, the building structures, and the reactor auxiliary facilities, (5) an automatic optimization of the turbine plant conditions and of the steam generator design, and (6) a final editing of the reactor plant conditions, and the capital, fuel, and operating components of the total electrical power costs.

CONTENTS

		Page
List o	f Tables	6
List o	f Figures	7
Acknow	ledgments	8
Introd	uction	9
Discus	sion	1-1
1.	Description of the Power Reactor Plant	1-1
2.	Computer Program	2-1
3.	Input Parameters	3-1
4.	Fuel Design	4-1
	4.1 Automatic Fuel Design 4.2 Pressure Tube Design 4.3 Heat Conduction to the Moderator	4-1 4-2 4-2
5.	Lattice Physics	5-1
6.	Core Design	6-1
7.	Fuel Cycle Costs	7-1
	7.1 Fuel Cost Subroutine 7.2 Fabrication Cost	7-1 7-2
8.	Reactor Design and Costs	8-1
	8.1 Reactor Shields	8-1
	8.1.1 Radial Thermal Shield 8.1.2 Axial Shield 8.1.3 Radial Biological Shield	8-1 8-3 8-4
	8.2 Primary Coolant System	8- 5
	8.2.1 Pressure Tubes 8.2.2 Pressure Tube Hardware and Extensions 8.2.3 Inner Housing Tube and Insulating Liners 8.2.4 Plenum Chambers 8.2.5 Primary Coolant Piping 8.2.6 Pumps and Motors 8.2.7 Steam Generators	8-5 8-6 8-8 8-9 8-10 8-13 8-14

CONTENTS (CONTINUED)

		Page
8.3	Reactor Tank	8-15
8.4	Moderator and Shield Cooling Systems	8-16
	8.4.1 Moderator Heat Exchanger 8.4.2 Moderator Piping 8.4.3 Moderator Pumps and Motors 8.4.4 D ₂ O Inventory 8.4.5 Storage Tanks 8.4.6 Shield Cooling System	8-16 8-17 8-17 8-18 8-19 8-19
8.5	Control and Safety Rods	8 - 19
8.6	Instrumentation and Monitoring	8-20
8.7	Reactor Enclosure and Fuel Charging Equipment	8-21
Reac	tor Building Structures and Auxiliary Reactor Systems	9-1
9.1	Containment Structures	9-1
	9.1.1 Containment Vessel 9.1.2 Containment Vessel Substructure 9.1.3 Containment Vessel External Treatment 9.1.4 Shadow Shielding 9.1.5 Internal Structures	9-1 9-2 9-3 9-3 9-3
9.2	Other Plant Structures	9-4
	9.2.1 Land and Land Rights 9.2.2 Access Roads and Improvements 9.2.3 Fuel Handling Building 9.2.4 Reactor Building Crane 9.2.5 Miscellaneous Structures	9-4 9-4 9-4 9-5 9-5
9.3	Coolant System Auxiliaries	9 - 5
	9.3.1 Coolant Makeup System 9.3.2 Coolant Purification System 9.3.3 Coolant Storage Tanks, Vents, and Drains 9.3.4 Coolant Particulate Removal System 9.3.5 Steam Tracing System	9-5 9-5 9-6 9-7 9-7
9.4	Off-Gas and Waste Disposal Systems	9-8
	9.4.1 D ₂ O·Distillation System 9.4.2 Waste Disposal for Aqueous Systems 9.4.3 Waste Disposal for Organic Systems 9.4.4 Waste Gas Handling System 9.4.5 Off-Gas System for the Moderator 9.4.6 Organic Degasification and Pressurizing	9-8 9-8 9-8 9-9 9-10
	Gratam	9-10

CONTENTS (CONTINUED)

		rage
10.	Operating and Maintenance Costs	10-1
	10.1 Organic Makeup	10-2
11.	Steam Generator Optimization	11-1
	11.1 Method of Optimization 11.2 Steam Generator Subroutines	11-1 11-2
	11.2.1 Input 11.2.2 Steam Pipe 11.2.3 Superheater 11.2.4 Boiler 11.2.5 Economizer 11.2.6 Optimization of Boiler Pressure	11-2 11-2 11-4 11-8 11-10
12.	Turbine Plant	12-1
	12.1 Turbine Plant Design 12.2 300-MWe Plants 12.3 500-MWe Plants 12.4 1000-MWe Plants 12.5 Turbine Efficiency Calculations 12.6 Turbine Plant Cost Calculations 12.7 Turbine Plant Optimization	12-1 12-2 12-2 12-3 12-3 12-4 12-5
13.	Cost Accounting	13-1
Append	dix A - Input Sheets	A-1
Rihlia	ography	B- 1

LIST OF TABLES

<u>Table</u>		Page
7.1	Equations for Fuel Cycle Cost	7-4
8.1	Coefficients in Shield Equations	8-22
12.1	Heater Outlet Temperatures - Saturated and Superheated Steam Cycle Analysis	12 - 6
12.2	Summary of 300-MWe $\rm H_2O$ Turbine Plant Characteristics	12-7
12.3	Summary of Cost Data - 300-MWe Indirect Cycle Turbine Plant	12-8
12.4	Summary of 500-MWe H ₂ 0 Turbine Plant Characteristics	12-43
12.5	Summary of Cost Data - 500-MWe Indirect Cycle Turbine Plant	12-44
12.6	Summary of 1000-MWe H ₂ 0 Turbine Plant Characteristics	12-79
12.7	Summary of Cost Data - 1000-MWe Indirect Cycle Turbine Plant	12-80
12.8	Coefficients for Turbine Efficiency Calculations	12-114
12.9	Equations for the Turbine Cost Calculations	12-116
12,10	Coefficients for Turbine Exhaust Flow Calculations	12-117
12.11	Coefficients in Cost of Saturated Steam Turbine Generator	12-118
12.12	Coefficients for the Correction to the Turbine Cost Due to Superheat	12-118
12.13	Coefficients for Cost of Turbine Plant	12-118

LIST OF FIGURES

Figure		Page
1.1	Flowsheet of Organic-Cooled System	1-2
1.2	Equipment Layout for 300-MWe Plant	1-3
1.3	Organic Reactor Calandria Design	1-8
2.1	Flowsheet for Computer Studies	2-3
11.1	Flow Diagram of Steam Generator Subroutine for Organic-Cooled Reactor Design	11-13
11.2	Temperature and Pressure Profiles in Steam Generators for Organic-Cooled D2C-Moderated Power Reactors	11-13
11.3	Steam Generator Optimization - Steam Piping Subroutine	11-14
11.4	Steam Generator Optimization - Superheater Subroutine	11-15
11.5	Steam Generator Optimization - Boiler Subroutine	11-16
11.6	Steam Generator Optimization - Economizer Subroutine	11-17
11.7	Steam Generator Optimization - Optimization Subroutine	1 1- 18
A-1	Power Reactor Cost Optimization Program - Input Data Form	A-2

ACKNOWLEDGMENTS

As mentioned in the report, Sargent & Lundy, Engineers, under contract with the Atomic Energy Commission, developed the design and cost information required for the reactor plant auxiliary systems, the building structures, and the turbine plant. The Du Pont Engineering Department, under the coordination of H. J. Kamack, developed the design and cost information for the reactor core and primary coolant system. The steam generator design was developed by J. S. Neill, while the programming and some of the optimization methods were developed by J. J. Bugg and J. G. Melvin (while on loan from AECL). The design of the computer code, the programming and much of the checkout were provided by J. C. Jensen. The collection of data and reduction to fitted polynomials, etc., was done by C. R. Tharin. R. R. Hood and L. Isakoff studied the organic reactor technology as developed by others and made recommendations on design criteria, material choices, etc. R. T. Huntoon collected data and developed the cost information on the uranium carbide fuel. D. S. St. John provided much of the direction and coordination for the code development as well as the overall studies of D_2 0 reactor concepts.

A COMPUTER PROGRAM FOR THE OPTIMIZATION OF ORGANIC COOLED D₂O REACTORS

INTRODUCTION

As part of the design and economics studies of heavy water power reactors, a computer program has been written in conjunction with Sargent and Lundy, Engineers, for performing the lengthy design and cost calculations required to determine the energy cost from a power plant. This computer code was originally written (1) for systems producing 300 MWe with reactors cooled by pressurized liquid D_20 or by boiling D_20 .

The original program was written for an IBM 650 computer with six tape units. Subsequently the code was rewritten in FORTRAN II language for an IBM 704 computer, and expanded to include organic cooling and 500- and 1000-MWe plants. Thus a code has been developed for handling liquid D_2O , boiling D_2O , or organic coolants at discrete plant sizes of 300, 500, and 1000 MWe.

Development work and design studies that were reported in $1962^{(2)}$ indicated that the organic-cooled, heavy water system offered potential for low cost nuclear power. At that time, the major development programs pertaining to the organic- D_2 0 concept were being carried out by Euratom as part of their ORGEL program, by AECL and Canadian General Electric within the Canadian program, and by Atomics International as part of the U. S. OMR program. Much of the coolant technology and plant design has been obtained through the courtesy of Atomics International and of AECL.

The design and costs for the turbine plants, reactor building structures, and reactor auxiliary facilities were developed by Sargent and Lundy (3,4,5). Summary descriptions of these parts of the plant have been included in this report along with the expressions for the costs; the reader is referred to the original Sargent and Lundy reports for more complete details.

Cost relationships for equipment and building structures were developed to express the variation in costs as a function of reactor size, coolant temperatures, steam pressures, etc, so that the reactor plant could be optimized. Cost equations were developed in terms of mass of material, volume of equipment, pumping or motor requirements, number of tubes, shield penetrations, etc, times appropriate unit costs. Therefore, equipment costs do not exhibit discontinuities as a function of size, facilitating optimization of plant designs. Unit costs are intended to be representative of a mature nuclear industry rather than

for a first-generation plant and thus are indicative of the potential of the reactor concept.

The objective of this report is to provide a companion report to $DP-707^{(1)}$ which covers D_2O -cooled systems. The numerous features of the program, which are common to both the D_2O and organic-cooled designs and are described in DP-707, will only be mentioned briefly.

DISCUSSION

1. Description of the Power Reactor Plant

The plant design for the organic reactor is based on a Sargent and Lundy design (6,7,8) that was updated on the basis of coolant technology supplied by Atomics International. The process flow diagram is shown in Figure 1.1.

The building arrangement and locations of the major pieces of equipment within the building are shown in Figure 1.2 for the 300-MWe design*. For the 1000-MWe designs, the building arrangement was modified to accommodate an increased number of steam generators.

A sketch of the reactor core is shown in Figure 1.3. The organic coolant enters the reactor core through a ring header and pigtail arrangement, passes up through the reactor and out through an outlet header to the steam generators. The moderator is contained in a calandria that is pierced by pressure tubes through which the hot organic flows.

The organic coolant that has been chosen is "Santowax"** R, with an equilibrium high boiler concentration of 10%. Reference 9 reports the properties of this organic as a function of high boiler concentration.

The computer program has been set up to allow the use of UO2 or UC fuel material, clad with SAP (sintered aluminum powder).

The turbine plant consists of a single-turbine generator unit with the associated condensers, circulating water system, feedwater heaters, booster feed pumps, condensate pumps, piping, filters, and turbine building.

Discrete turbine plant designs have been developed by Sargent and Lundy for 325, 525, and 1050 gross electric megawatts. These designs include throttle conditions from 400 to 1500 psia with from 0 to 500°F of superheat and one to seven stages of feedwater heating.

^{*} The 500-MWe design had the same general arrangement as the 300-MWe plant.

^{** &}quot;Santowax" is trademark of Monsanto Chemical Co.

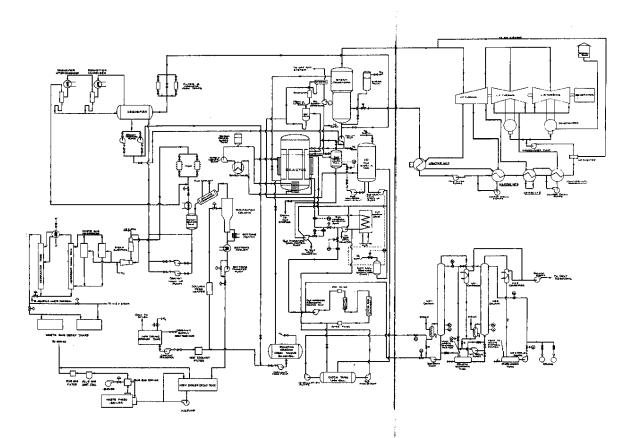


FIG. 1.1 FLOWSHEET OF ORGANIC - COOLED SYSTEM

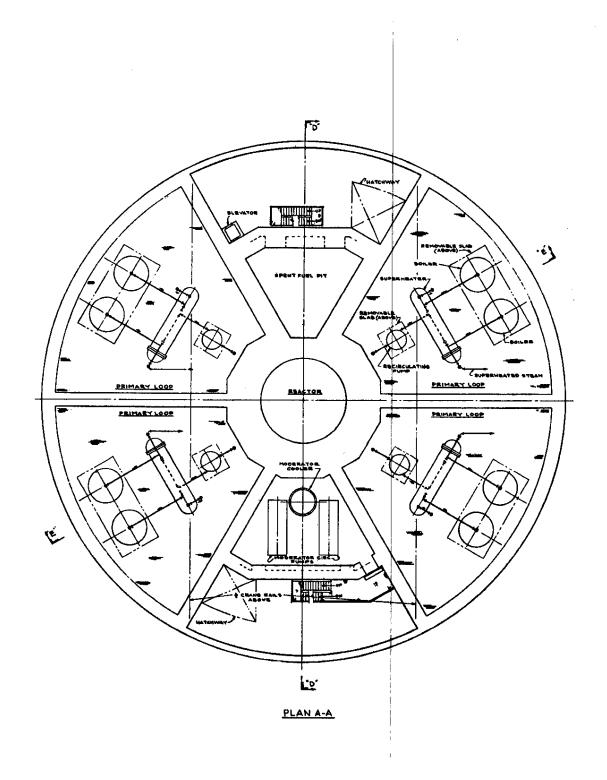


FIG. 1.2 EQUIPMENT LAYOUT FOR 300-MWe PLANT

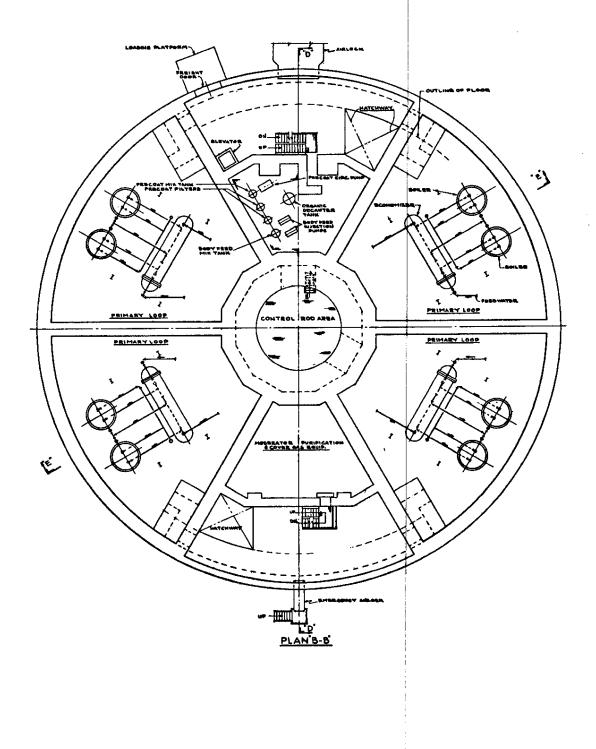


FIG. 1.2 (Continued)

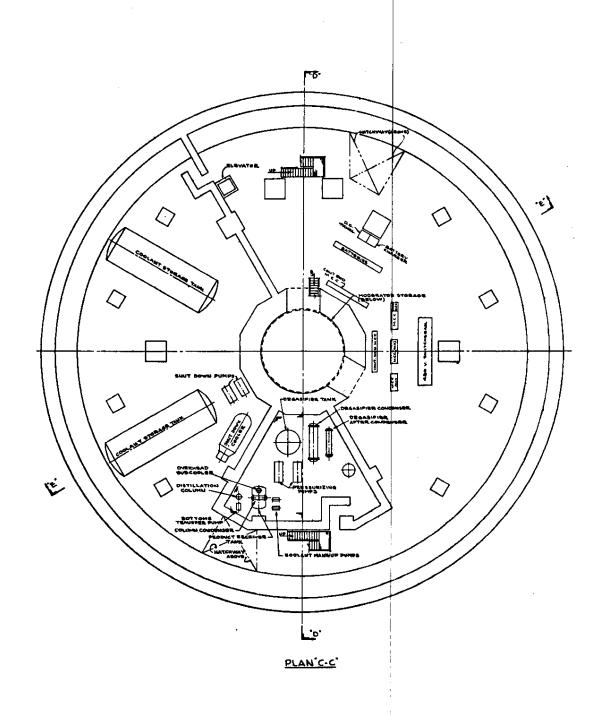
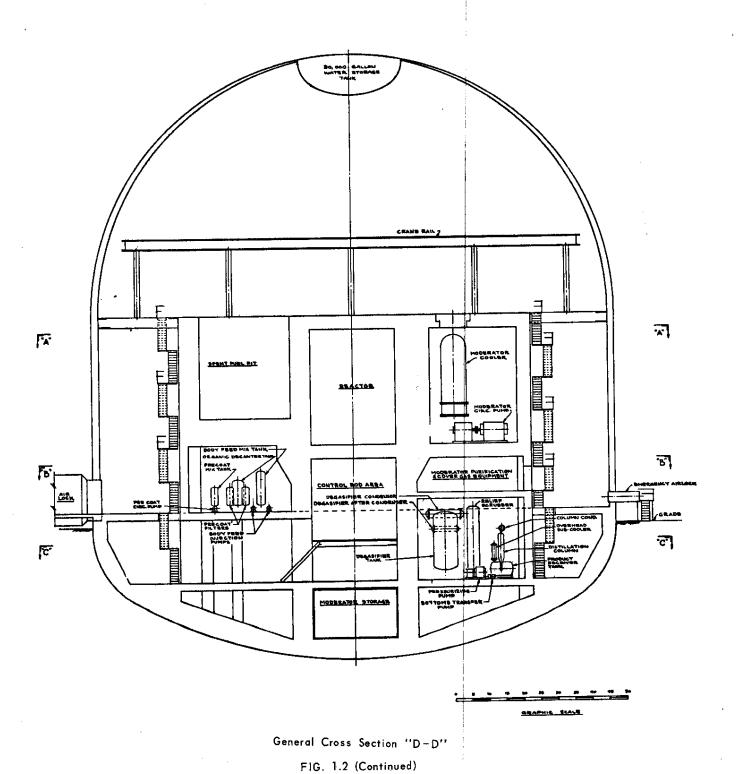
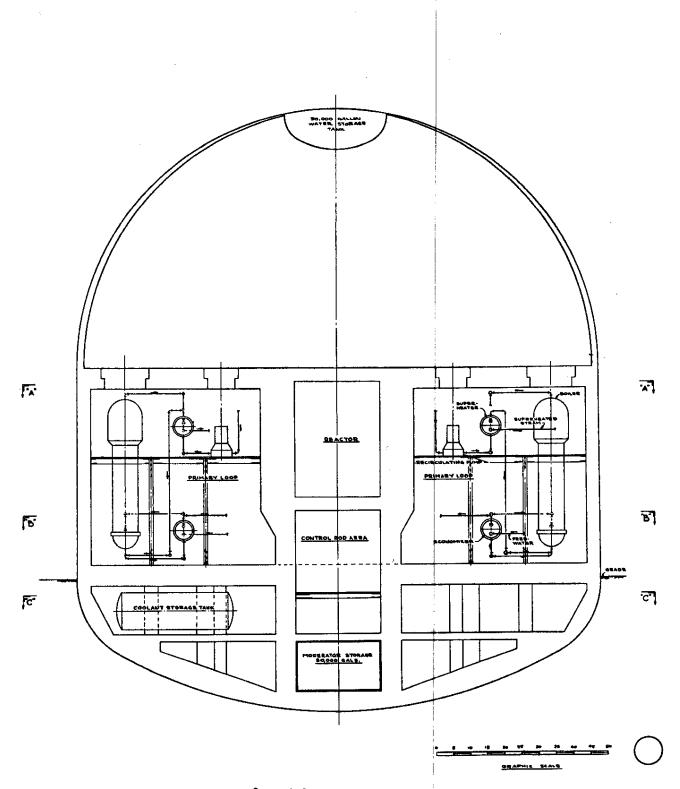


FIG. 1.2 (Continued)



1-6



General Cross Section "E-E"

FIG. 1.2 (Continued)

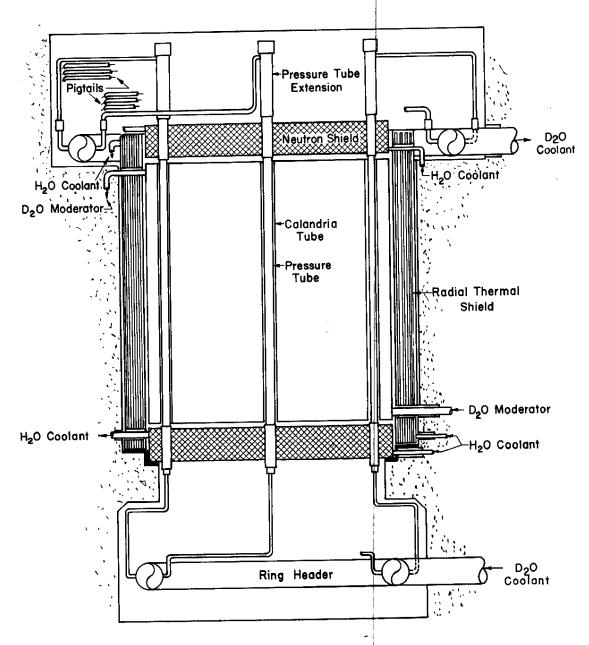


FIG. 1.3 ORGANIC REACTOR CALANDRIA DESIGN

2. Computer Program

The computer program consists of eight major "blocks." A simplified flow diagram of the code is shown in Figure 2.1, and a brief description of each function is given below.

(1) Input

Input parameters are supplied for each problem, including fuel and cladding material, pressure tube material, number of fuel tubes per assembly, mass of fuel per foot of length, coolant temperatures, thermal power, and engineering limits.

(2) Fuel Design

The dimensions and maximum power of a fuel assembly are calculated from input parameters and a set of engineering criteria.

(3) Lattice Physics

Reactivity parameters of the infinite lattice are calculated from the dimensions and materials of the fuel assembly, the lattice pitch, and the operating temperatures of the fuel, coolant, and moderator.

(4) Core Design

The number of fuel positions in the reactor core are computed from the required thermal power and power output of a fuel assembly as computed in the fuel design. Fuel exposure and spent fuel assays are calculated on the basis of one of the fuel charging schemes and the reactivity calculated in the lattice physics block.

(5) Fuel Fabrication

Fuel fabrication cost and fuel cycle costs are computed from the dimensions, materials, and exposures of the fuel assembly.

(6) Reactor

Major pieces of equipment in the reactor and primary coolant system are designed from the coolant flow rates and reactor core size as calculated in the core design. An estimate of the cost of each piece of equipment is made on the basis of its design.

(7) Auxiliaries and Building Structures

Designs and cost estimates are obtained for the various auxiliary facilities required in the reactor plant, and for the containment shell and building structures included in the reactor plant.

(8) Turbine Plant

Turbine plant design and cost are obtained for each problem by determining the turbine plant conditions that give the minimum over-all energy costs. These conditions depend upon the reactor coolant temperatures and the sum of all of the capital and operating costs, and are optimized by calculating the energy costs for a number of turbine plant designs in order to find the optimum.

(9) Final Accounting

Energy costs for the plant are computed from economic ground rules specified as part of the problem.

(10) "Fixed Fuel Design"

The fuel design and lattice physics routines can be bypassed by supplying fuel assembly lattice physics properties and having the code compute the reactor design and costs for the specified fuel assembly. In this way it is possible to study fuel assembly designs other than the annular fuel geometry, such as rod or plate-type fuel clusters.

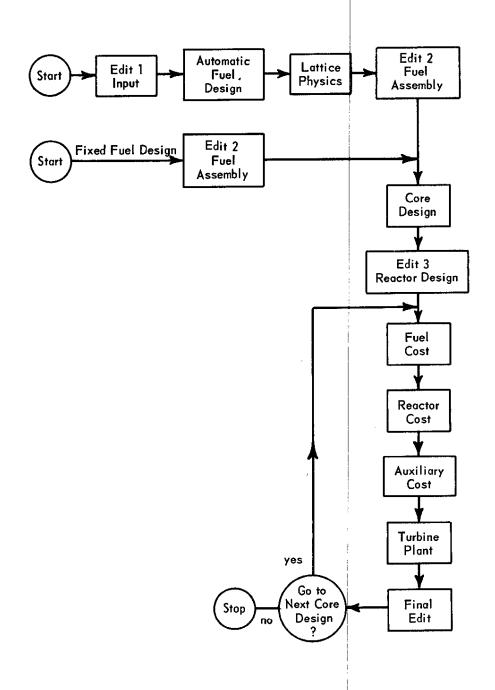


FIG. 2.1 FLOWSHEET FOR COMPUTER STUDIES

3. Input Parameters

Major design variables are included in the list of input required for each problem. Other variable parameters may be read into the code from a library tape. Thus, in the use of the code it is necessary to specify the library file required for each problem; with the use of a series of library files, a parameter on the library file may be varied and its effect studied. The effects of capital charge rates, the price of plutonium, reprocessing costs, and design stress of zirconium as a function of temperatures can be studied in this way.

The list of input required for each problem is given below. The input sheets for a typical problem are shown in Appendix A.

Fuel Assembly

Fuel material, UO2 or U metal Fuel length, in. Mass of fuel (UO2 or U metal) per unit length, lb/ft Number of concentric tubes Cladding material, Zr, Al, or SS Fuel density (for UO2 only), % of theoretical ²³⁵U content in fuel, atom % Thickness of outer coolant channel, mils Insulating liner or calandria tube material, Zr or Al Space between the pressure tube and liner (or calandria tube), mils Inner housing tube, yes or no Length of reactor core, in. Number of fuel pieces in the reactor length Cladding thickness, mils Pressure tube material, Zr or Al

Design Limits

Maximum surface temperature of cladding, ^oC Minimum burnout safety factor Maximum central fuel temperature, ^oC

Reactor Core

Coolant inlet temperature, °C
Coolant outlet temperature, °C
Moderator temperature, °C
H₂O in moderator, %
Axial reflector thickness, in.
Radial reflector thickness, in.
Number of control rods
Number of safety rods
Reactivity held in control rods (k_{eff})
Lattice pitch, in.
Lattice pattern, hexagonal or square
Degree of flattening

Reactor System

Load factor
Thermal power removed by coolant, MW
Reactor discharge time, days

4. Fuel Design

4.1 Automatic Fuel Design

The fuel design block is for fuel assemblies that consist of two or three concentric tubes of fuel clad with SAP (sintered aluminum powder). Dimensions and power output are computed so that a maximum power can be obtained from the assembly and so that the temperatures and pressure drops are consistent with the design criteria. The design criteria that must be satisfied are: (1) equal pressures along the subchannels, (2) equal coolant temperatures along each subchannel, and (3) equal maximum surface temperatures on each fuel tube. The power is progressively increased in the calculations until one of the design limits is reached. The limits specified in the input to each problem are (1) maximum fuel temperature, (2) maximum surface temperature, and (3) minimum safety factor on heat transfer burmout.

This block of the code, which was originally written for use with liquid D_2 0 cooling, is described in detail in $PP-784^{(10)}$.

The liquid D_2O code has been modified for organic coolant by making the appropriate changes in the coolant, cladding, and fuel properties. The coolant properties (9) of "Santowax" R were substituted for the properties of pressurized D_2O . The equation for the burnout heat flux is given by

$$(Q/A)_{BO} = 552T_s V^{2/3} + 85,000$$

where

 $(Q/A)_{RO}$ = heat flux at burnout, $pcu/(hr)(ft^2)$

 T_g = subcooling at burnout site, ${}^{\circ}C$

= saturation temperature minus the local bulk temperature

V = coolant velocity, ft/sec

As with the liquid $D_2{\rm O}$ cooled case, the heat transfer coefficient, h, is computed from

$$h = \alpha(T_0) \frac{v^{0.8}}{D_e^{0.2}} [1 + 0.005(T_s + T_B)]$$

where

V = coolant velocity, ft/sec

De = hydraulic diameter of the coolant annulus, in.

 T_s = surface temperature of the fuel, ${}^{\circ}C$

 $T_{\rm R}$ = bulk temperature of the coolant, ${}^{\rm O}$ C

 $\alpha(T_0)$ = fitted parameter that is a function of the coolant outlet temperature

4.2 Pressure Tube Design

The pressure tube thickness is computed from

$$t = \frac{p_d D}{2S}$$

where

t = thickness of the pressure tube, in.

p_d = design pressure of reactor, psia

D = inner diameter of the pressure tube, in.

S = design stress of the pressure tube material at the design temperature, psia

and the design temperature is taken to be the outlet temperature from the fuel assembly.

4.3 Heat Conduction to the Moderator

Heat is conducted from the outer coolant channel through the pressure tube to the moderator surrounding the fuel assemblies. The heat flux is computed from

$$(q/A) = \Delta T \left(\frac{1}{h_g} + \frac{t}{k_p} + \frac{1}{h_m}\right)^{-1}$$

where

q/A = heat flux through the pressure tube, $pcu/(hr)(ft^2)$

 ΔT = average temperature difference between the coolant and moderator, ${}^{\circ}C$

$$\Delta T = \left(\frac{T_0 + T_1}{2} - T_m\right)$$

where

 $T_0, T_1 = \text{reactor outlet}$ and inlet temperatures, ${}^{\circ}C$

 $\mathbf{T}_{\mathbf{m}}$ = average moderator temperature, $^{\mathrm{O}}\mathrm{C}$

h_m = heat transfer coefficient of the moderator interface, pcu/(hr)(ft²)(°C)

hg = heat transfer coefficient across the insulating gap, pcu/(hr)(ft²)(°C)

k_p = thermal conductivity of the pressure tube material, pcu/(hr)(ft)(°C)

t = pressure tube thickness, ft

For the pressure tube designs where the insulating gap is inside the pressure tube, the value of hg is the heat transfer coefficient across the insulating material, whereas for the calandria designs, hg is the heat transfer coefficient across the gas gap.

5. Lattice Physics

Lattice physics parameters for the infinite cell are computed from the fuel dimensions and temperatures of the fuel assembly. All of these parameters are either specified in the original input to the code or are computed in the fuel design portion of the code. The values of η , ε , p, f, L^2 , τ , and B^2 are computed by a method developed at $SRL^{\{11\}}$, and has been adjusted by comparison with a large number of experiments to give accurate reactivity calculations over a large range of heavy water lattices. The majority of the comparisons between experiments and calculations have been made with $D_2\text{O-cooled}$ lattices. Only about a dozen experiments with hydrogenous coolant are available for comparison with calculations, and it has been found that the normalization required to fit these experiments is the same as for the $D_2\text{O-cooled}$ case.

6. Core Design

The core design block uses the results of the fuel design and lattice physics portions to compute the reactor dimensions, power output, and fuel life for several fuel charging strategies. Three fuel charging strategies are considered with each problem. The core designs do not differ in the core dimensions or number of fuel assemblies, but only in the assumed fuel handling procedure and the degree of power flattening that results. A detailed description of the method of calculations are given in the Appendix of DP-707 (1). The three fuel handling schemes are as follows:

Case 1 - Batch Refueling

Case l is the base case. The core dimensions and number of fuel assemblies are determined so that this reactor produces the required power (an input parameter) for an assumed power distribution of a chopped $J_{\rm O}$ -cosine. The fuel life for this case is obtained for a simple batch discharging scheme. The entire core is discharged when the reactivity falls below the minimum value, $\Delta k_{\rm C}$, that is required for xenon override and flux trimming.

Case 2 - Continuous Countercurrent Refueling

case 2 is characterized by a continuous charging scheme in which each bit of fuel receives the same exposure. The chopped J_0 -cosine power distribution for Case 1 is maintained, but a longer exposure of the fuel is achieved by balancing the fuel elements of high exposure with fuel material of adjacent lattice positions. In this procedure the power distribution remains constant and the reactor power is the same as in Case 1.

Case 3 - Graded Two-Zone Refueling

Case 3 is characterized by a continuous two-zone refueling scheme. The power distribution is flattened by charging fresh full-length fuel assemblies into the central zone at a rate such that the mean radial buckling is zero. Assemblies are charged in the outer zone at a rate required to maintain criticality and compensate for the low reactivity of the central zone. In this procedure, reactivity or core life is sacrificed to gain improved power distribution. Because of this better power distribution, the total power is higher than in Case 1 or Case 2. The degree of flattening or the total thermal power is at the discretion of the user of the code.

The input for the core design block is obtained from the initial input or from the output from the fuel design and lattice physics blocks and includes the following:

Initial Input

Lattice pitch
Lattice pattern
Length of fuel assembly
Weight of fuel
Enrichment of fuel
Number of safety rod positions
Minimum amount of reactivity required for control
Radial reflector thickness
Vertical reflector thickness
Time required to replace spent fuel in Case 1
Degree of flattening in Case 3
Total power sent to steam plant in Case 1 and Case 2

Input from Fuel Design

Power removed by coolant in central assembly Total power generated in central assembly Coolant flow in central assembly

Input from Lattice Physics

Initial hot clean buckling of the lattice cell Migration area Resonance escape probability

The amount of reactivity desired for operational control is an input parameter, and the amount of reactivity lost to xenon-samarium is computed from the average power. The reactivity lost to Doppler broadening is computed from the average temperature of the central fuel assemblies as computed in the fuel design block.

The number of fuel assemblies in the core is adjusted to give the desired thermal power of the reactor for Case 1, which establishes the size of the core and the over-all reactor dimensions. For Case 3, the amount of power flattening is automatically adjusted to give the desired thermal output for Case 3.

An expression for reactivity change as a function of the exposure and resonance escape probability has been standardized in the form of the following polynomial:

$$\Delta k = \sum_{i} a_{i} E^{n_{i}} p^{m_{i}}$$

where E is the exposure, and p is the resonance escape probability. The coefficients a are computed separately in part by side studies and in part, internally in the code. The method for computing the a 's and some of the results of the side studies are described in DP-707⁽¹⁾. The reactivity loss due to temperature, leakage, control, and xenon-samarium is first subtracted from the initial hot reactivity of the lattice. The remainder of the available reactivity determines the core life of the fuel. The exposure at discharge is then computed from the root of the polynomial.

Included in the output from the core design block are the exposures, throughput, fuel inventory, and the assays of the spent fuel in the inner and outer regions of the reactor. These quantities are required primarily for the fuel cycle costs. The thermal flux of the core reflector interface is computed for use in the shield design calculations. Also, the total coolant flow, the D_2O in the reactor core and reflector, and the heat load on the moderator are computed for use in the determination of the reactor building and equipment costs.

7. Fuel Cycle Costs

7.1 Fuel Cost Subroutine

In this subroutine the charges associated with the fuel cycle are computed by one of two alternative cost accounting procedures. The two procedures correspond to two methods of handling the spent fuel. One procedure essentially follows the AEC method as outlined in the Cost Evaluation Handbook (12). This AEC charge schedule has been modified so that \$0.15/kg U and \$2.50/kg U are taken for the shipping charges for new and spent fuel. The alternative procedure assumes that spent fuel is stored at the reactor site and not processed.

The input required for the determination of the fuel cycle costs includes dimensions of the fuel assembly, initial enrichment of the fuel, isotopic assays of the plutonium and uranium-235 in the spent fuel, exposure of the fuel, throughput of the fuel, and the inventory of fuel in the reactor. These input parameters are determined in preceding blocks of the program.

The output from the fuel cycle cost subroutine lists the following charges for both the outer (buckled) zone and central (flat) zone fuel:

Exposure, MWD/tonne

Throughput, tonnes/yr

Fabrication cost, \$/kg U

Manufacturing cost, which includes the fuel preparation cost, fabrication cost, and the cost of shipping new fuel, \$/kg U

Fuel burnup cost, which includes the net credit of plutonium and 235U, \$/kg U

Use charges, \$/kg U

Fuel cost, \$/kg U

For each of the fuel charging schemes, the following charges are listed:

Annual reactor fuel cost, \$/yr

Annual throughput, kg/yr

Average exposures, MWD/tonne

Reactor fuel cycle cost, mills/kwh

7.2 Fabrication Cost

The fuel fabrication cost has been estimated by assuming that a separate plant will be constructed to furnish fuel elements that are required by the reactor design. Estimates have been made of the capital outlay and operating expenses required to build and operate a fuel fabrication plant for this purpose. Fabrication costs have been developed for the manufacture of UO₂ tubes by mechanical compaction and for the manufacture of uranium carbide tubes by a skull casting process. The manufacturing costs for uranium oxide tubes clad in Zircaloy have been published previously (13), and the fabrication costs for the uranium carbide tubes are described below.

The cost of manufactured uranium carbide has been developed by analyzing the investment and operating costs of a plant to produce about 300 kg of uranium carbide per shift. The process consists of skull melting and casting for the manufacture of uranium carbide. The cast uranium carbide tubes are then assembled in SAP sheaths, and nickel-plated end plugs are attached by an aluminum eutectic braze. These operations were developed by Atomics International. The costs have been developed so that it is possible to estimate the effect of plant throughput and fuel assembly dimensions on the unit cost of the fuel.

The variable costs include the cost of materials (not including the cost of components), the cost of laboratory analyses, direct labor, and distributives which include supervision, services, maintenance, and miscellaneous supplies. These variable costs have been divided into those that depend upon the mass of fuel processed and those which depend upon the number of tubes processed. The variable costs that depend upon the mass of fuel processed are \$1293/shift, or \$4.65/kg of U. The costs that depend upon the number of tubes processed are \$1183/shift or

$$\frac{14,800}{(b^2-c^2)L}$$
, \$/kg U

where

b and c = OD and ID of the uranium carbide core, cm

L = length of the core, cm

The fixed costs are made up of the following:

- (1) Indirect plant costs, including depreciation, taxes, and insurance
- (2) Overhead
- (3) Management expense
- (4) Inventory charge

These charges total \$114/tube, or,

$$\frac{12,700}{(b^2-c^2)L}$$
, \$/kg U

In addition, a component of the fixed charge costs can be expressed as a unit cost of \$115/T, where T is the throughput in tonnes U/year.

The cost of the end plugs is calculated from the weight of the end plugs, which are assumed to be 6 inches long, cost \$6/lb and have a machining cost of about \$20/pair. The assumed rejection rate is 15%. The expression for the end plug cost is then

$$\frac{50}{L} + \frac{23.3}{(b^2 - c^2)L}, $kg U$$

The cost of the SAP sheaths is computed from the mass of the material and an assumed cost of \$12/1b of SAP. The sheath cost, SHC, is given by

$$SHC = \left[\frac{\pi}{4} \frac{(a^2 - b^2 + c^2 - d^2)}{(2.54)^2} + 0.060\right] \left[\frac{L}{2.54} + 2.0\right] \left[\frac{1}{1 - r_1}\right] \left[\frac{1}{1 - r_2}\right] \left[\rho_a C_a\right]$$

where

a and d = OD of the outer sheath and the ID of the inner sheath, respectively, cm

 $rib area = 0.060 in^2$

r₁ = rejection rate of the SAP sheaths during receiving and inspection = 0.20

 r_2 = rejection rate during inspection of the finished fuel elements = 0.15

 ρ_a = density of the SAP, lb/in³

 C_{a} = unit cost of the SAP = \$12/1b

These component costs are then combined to give the Equation 4b listed in Table 7.1.

TABLE 7.1
Equations for Fuel Cycle Cost

	Equation Number			
		counting cedure	Throwaway Accountin Procedure	
	Natural	Enriched	Natural	Enriched
Cost	Uranium	Uranium	Uranium	Uranium
Uranium	la	1b	la	1b
Fuel preparation				
Fused UO2	2 a .	2c	2a	2c
Uranium carbide	2b	2b	5 <i>p</i>	2ⴆ
Losses in fuel preparation	3	3	3	3
Fuel fabrication		9		
UO2 tubes	4a	4а :	4a	Ψa
Uranium carbide tubes	4 b	4ъ	4b	4b
Losses in fabrication	5	5	5	5
Shipping new fuel	6	6	6	6
Shipping spent fuel	7	7	-	***
Storing spent fuel	-	_	8	8
Depleted fuel price	9	9	-	
Uranium recovery	10	10	-	-
Reprocessing	11	11	-	-
Plutonium recovery	12	12	-	-
Fuel burnup	13a	13a	13b	13b
Use charges		14a	-	14b
Summary costs				
Manufacturing	15	15	15	15
Total fuel	16 a	16b :	16 a	16b
Fuel cycle	17	17	17	17

TABLE 7.1 (Continued)

Equations

Number	Equation
la	A = 21.0
1b	$A = f(\alpha)$ where $f(\alpha)$ is the cost of uranium as a function of enrichment
2a	$N = 6.25 \left(1 + \frac{\beta + \delta + \gamma}{100}\right)$
2b	$N = 3.64 \left(1 + \frac{\beta + \delta + \gamma}{100}\right)$
2c	$N = (6.1 + 2.2\alpha) \left(1 + \frac{\beta + \delta + \gamma}{100}\right)$
3	$P = A \frac{\gamma}{100} \left(1 + \frac{\beta + \delta + \gamma}{100} \right)$
4a	$c_{1} = \frac{138.5}{\rho_{\text{UO}_{2}}(b_{1} - c_{1})L(1 - R_{1})} \left[\frac{32.8}{\pi} \frac{(F_{1} + \epsilon_{1})}{(b_{1} + c_{1})} + 0.215(L + L_{1})tc_{Z_{1}} \right]$
	$\omega_{\mathbf{i}} = b_{\mathbf{i}}^{2} - c_{\mathbf{i}}^{2}$
	$R = \frac{\sum_{i}^{\infty} \omega_{i}^{C_{i}}}{\sum_{i}^{\infty} \omega_{i}}$
46	$C_{i} = 4.65 \frac{27.500}{(b_{i}^{2} - c_{i}^{2})L} + \frac{50}{L} + \frac{115}{T} +$
	$\frac{170}{(b_1^2 - c_1^2)L} = 0.122(a^2 - b^2 + c^2 - d^2) + 0.060(\frac{L}{2.54} + 2)$
5	$S = \frac{A\delta}{100} \left(1 + \frac{\beta + \delta}{100} \right)$
6	U ₁ = 0.15
7	U ₂ = 2.50
8	SS = 2.50
9	$B = f(\alpha')$

TABLE ((Continued)	
Number	Equation	n
10	$DD = a_4 a_5 a_6$	
11	$CC = a_2 \frac{[TT + F/G]}{F}$	
12	$EE = a_7 \ a_8 \ a_9 (g_1 + g_2 + g_3)$	nagger man Car Car
13a	$PP = XX + [U_2 + CC - r_j(g_1 + g_2 +$	g ₃) + EE]
	where $XX = A$ if B	- DD ≤ 0
	and $XX = A - B + DD$ if B	- DD >0
13b	PP = A + SS	
14a	$Q = a_1 \frac{A\theta}{12} \left(1 + \frac{\beta + \delta + \gamma}{100} \right)$	•
	$T = a_1 A \frac{\lambda}{12} \left(1 + \frac{\beta + \delta}{100} \right)$: -
	$W = a_1 A \frac{\mu}{12}$	
	$Y = a_1 A \frac{Je}{\tau}$	
	$Z = a_1 \frac{e}{2\tau} [A + B]$,
	$AA = a_1 B \left(\frac{F}{\tau} + \frac{1}{365} \left[\frac{F}{G} + \frac{F}{1000} + a_3 \right] \right)$	
	WW = Q + T + W + Y + Z + AA	4
14b	WW = Q + T + W + Y + Z	
15	$V = N + P + R + S + U_1$!
16a	$F_c = V + PP$!
16b	$F_{C} = V + PP + WW$	
17	$E_{c} = \frac{F_{c}(10^{5})}{24 \eta E}$	

TABLE 7.1 (Continued)

Symbols in Equations

Symbol	Value	Description
a _i	-	OD of clad tube, cm
a ₁	0.0475	use charge rate
a ₂	17,500	reprocessing cost, \$/day
a ₃	35	holdup time in reprocessing, days
84	5.6	nitrate conversion cost, \$/kg U
8. ₅	0.99	separation efficiency of nitrate conversion
æe	0.997	conversion efficiency of nitrate conversion
a. ₇	1.5	cost of plutonium reduction, \$/g Pu
as	0.99	separation efficiency
a ₉	0.99	conversion efficiency
a ₁₀	3.0	tube length beyond core, ft
A	-	cost of uranium, \$/kg
AA	-	use charge associated with the fuel during reprocessing, \$/kg
b _i	-	OD of core, cm
В	_	price of the uranium in the spent fuel, \$/kg
c _i	_	ID of core, cm
Ci	-	fuel fabrication cost per fuel element, \$/kg
$^{\mathtt{C}}\mathtt{Z}_{\mathtt{l}}$	99.0	Zircaloy-2 cost in UO2 tubes, \$/kg Zircaloy
CC	-	fuel processing cost, \$/kg
đį	-	ID of clad tube, cm
DD	5.60	cost of uranium recovery, \$/kg
е		fuel inventory in the core, kg
Ē	-	exposure of the fuel, MWD/tonne
$^{\mathrm{E}}\mathrm{_{C}}$	-	fuel cycle cost, mills/kwh
EE	-	plutonium recovery cost, \$/kg
F	25,000	reprocessing batch size, kg
$^{\mathrm{F}}\mathrm{c}$	-	total fuel cost, \$/kg
$\mathtt{F}_\mathtt{1}$	154	fixed and variable costs of UO2 tubes, \$/element

TABLE 7.1 (Continued)

Symbol	<u>Value</u>	Description
gı	-	239 Pu concentration in spent fuel, g/kg
g ₂	-	240Pu concentration in spent fuel, g/kg
gs	_	241Pu concentration in spent fuel, g/kg
G	1000	reprocessing rate, kg/day
J	0.5	fraction of core in spare fuel
L	-	length of fuel in core, cm
$\mathtt{L_1}$	2.5	trimming loss of Zr in UO2 tubes, cm
N	-	cost of fuel preparation, \$/kg
P	-	cost of fuel material lost in fuel fabrication, \$/kg
PP	-	fuel burnup cost, \$/kg
ର	-	use charge associated with the fuel during fuel conversion, \$/kg
rj	9.50	Pu price, \$/g
R		fuel fabrication cost per fuel assembly, \$/kg
R_1	0.15	fraction of UO2 tubes rejected
S	-	fuel material lost in fuel fabrication, \$/kg
SS	2.50	storage cost of irradiated fuel, \$/kg
t	_	cladding thickness, cm
T	_	use charge associated with the fuel during fuel fabrication, \$/kg
TT	8	turnaround time, days
$\mathtt{U}_\mathtt{l}$	0.15	shipping cost for new fuel, \$/kg
U ₂	2.50	shipping cost for spent fuel, \$/kg
V	-	manufacturing cost, \$/kg
W		use charge associated with the fuel during storage, \$/kg
WW	-	total use charges, \$/kg
Y	_	use charge associated with the spare fuel, \$/kg
Z	-	use charge associated with the fuel during irradiation, \$/kg
α	-	initial ²³⁵ U enrichment, wt %
a i	•	final 235U enrichment, wt %

TABLE 7.1 (Continued)

Symbo	l Value	Description			
β	10	recoverable scrap, %			
γ	0.8	nonrecoverable loss in preparation, %			
δ	1.2	nonrecoverable loss in fabrication, %			
$\epsilon_{\mathtt{l}}$	50	cost of end plugs of UO2 tubes, \$/element			
η		over-all plant efficiency, %			
θ	1.0	fuel preparation time, months			
λ	3.0	fabrication time, months			
μ	3.2	new fuel shipping time, months			
$ ho_{Z}^{}$	6.4	density of zirconium, g/cm			
ρ _{UO2}	-	density of UO2, g/cm3			
τ	-	throughput, kg/yr			

8. Reactor Design and Costs

The reactor consists of a cylindrical calandria tank containing $\rm D_2O$ moderator that is pierced by coolant tubes of either SAP or zirconium alloy. The coolant tubes are connected to plenum chambers above and below the reactor. The organic coolant passes from the reactor and outlet plenums through either four or eight parallel loops to the steam generator complex which consists of a superheater, two boilers, and an economizer in each loop. The superheated steam from each of the loops is combined in header piping and is sent to the turbine plant.

Much of the technology associated with this reactor system has been established by Atomics International in their work on the OMR systems. This work provided a basis for formulating much of the design criteria of this system. The general design and cost philosophy has been kept the same as in the D_2 O-cooled studies whenever possible so that in these aspects the systems would be comparable.

8.1 Reactor Shields

Three types of shields are considered: (1) the radial thermal shield consisting of 50% H₂O and 50% stainless steel, (2) the radial biological shield of concrete, and (3) the axial shield consisting of 40% H₂O and 60% stainless steel.

A study was made to determine the required shield thicknesses as a function of the reflector thickness and the neutron flux at the core-reflector interface. The results of this study were then fitted to polynomials for use in the computer code. Similar expressions were obtained for the heat generation in the radial and axial shields for determination of the shield cooling requirements.

8.1.1 Radial Thermal Shield

The radial thermal shield is designed so that it reduces the maximum energy flux that is incident on the concrete biological shield to less than 30 Btu/(hr)($\rm ft^2$) during reactor operation. This shield consists of an annular tank of stainless steel containing stainless steel plates that are cooled with $\rm H_2O$. The thickness of the radial shield.

t = thickness of radial shield, cm

t, = thickness of radial reflector, cm

 ϕ_1 = thermal flux at the core-reflector interface at the reactor midplane, n/(cm2)(sec)

a_{i,j} = coefficients of polynomial given in Table 8.1

The heat generation in the shield,

$$q_{rs} = C_1 HR_s \phi_1 \sum_{i,j} b_{i,j} t_r^i t_{rs}^j$$
 $i = 0,1,2$ $j = 0,1,2$

where

 q_{rs} = heat load on the side shield, Btu/hr

 R_s = inner radius of shield, cm

H = height of reactor core and reflector, cm

 $C_1 = 17.5 \times 10^{-13}$

b_{i,j} = coefficients of polynomial given in Table 8.1

The cost of the radial shield, RTS, is expressed as a function of the weight of the shield times the unit cost of steel, which includes the cost of the material, fabrication, and installation.

RTS =
$$\left[(d_c + 2t_r + 2t_{rs})^2 - (d_c + 2t_r)^2 \right] \frac{\pi}{4} (h_c + 12) v_1 \rho_1 C_2$$

where

d = diameter of the reactor core, in.

 v_1 = volume fraction of the stainless steel = 0.5

 C_2 = installed cost, \$/1b = 1.80

 t_{rs} = thickness of the radial shield, in.

 $t_r = radial reflector thickness, in.$

 ρ_1 = density of stainless steel = 0.28 lb/in³

h = height of the reactor core, in.

8.1.2 Axial Shield

The top and bottom shields are designed so the radiation level after shutdown due to cobalt activation in the shield is less than 1 mr/hr and the maximum neutron leakage in the area above the shield is less than 10^5 n/(cm²)(sec) during reactor operation. The neutron leakage criteria are the more restrictive. The thickness of the axial shield is

where

t_{ts}, t_{bs} = top and bottom shield thicknesses, cm

tar = axial reflector thickness, cm

 ϕ_2 = maximum thermal flux at the core-reflector interface, $n/(cm^2)(sec)$

d_{ij} = coefficients of the fitted polynomial and are given in Table 8.1

The heat generation in the axial shields is given by the following expression:

$$\begin{bmatrix} q_{bs} \\ q_{ts} \end{bmatrix} = C_3 R_c^2 \phi_z \sum_{i,j} e_{i,j} t_{ar}^i \begin{bmatrix} t_{bs}^j \\ t_{ts} \end{bmatrix}$$

$$i = 0,1,2$$

$$j = 0,1,2$$

where

q_{ts},q_{bs} = heat generated in the top and bottom shields, Btu/hr

R_c = radius of the reactor core, cm

 $C_{s} = 5.5 \times 10^{-18}$

eij = coefficients of the polynomial given in Table 8.1

The axial shields consist of plate and tube shields with particulate filler of stainless steel. The construction of the shield permits recirculation of the cooling $\rm H_2O$. The cost is expressed in terms of the gross weight and the number of tubes that pierce the shield.

$$\begin{bmatrix} \text{USH} \\ \text{LSH} \end{bmatrix} = \left(d_c + 2t_r + 2t_{rs} \right)^2 \frac{\pi}{4} \begin{bmatrix} t_{ts} \\ t_{bs} \end{bmatrix} v_4 \rho_1 C_4 + \begin{bmatrix} n_f + n_c \\ n_f \end{bmatrix} C_5 + \begin{bmatrix} n_g \\ 0 \end{bmatrix} C_6$$

USH, LSH = cost of the upper and lower shields

tts and tbs = thickness of the upper and lower neutron shields, in.

 v_2 = volume fraction of stainless stet = 0.60

 C_4 = general fabrication and installation cost, \$/1b = 2.0

 $C_5 = cost per lattice position, 200

C₆ = cost per safety rod position, \$150

 n_f = number of fuel positions

 n_c = number of control positions

n_s = number of safety rod positions

8.1.3 Radial Biological Shield

The concrete biological shield is designed to reduce the maximum radiation level during reactor operation to 1 mr/hr for which the required thickness is 9.5 ft. The cost of the biological shield, RBS, is expressed in terms of the volume of concrete surface area of the shield and the mass of reinforcing steel.

RBS =
$$(d_c + 2t_r + 2t_{rs} + t_s)(h_c + 2t_{ar} + t_{ts} + t_{bs} + t_1)$$

$$\times \left[\pi t_s \frac{C_7}{(36)^3} + \frac{2\pi}{144} (a_1 C_8 + C_9) \right]$$

where

ts = thickness of the biological shield, in.

t₁ = height of the biological shield above the moderator tank, in.

 $C_7 = cost of concrete, $/yd^3 = 25$

 a_1 = amount of reinforcing steel, $\$/ft^2 = 4.0$

 $C_8 = \text{cost of reinforcing steel}$, \$\frac{1}{1}b = 0.2

 $C_8 = \text{cost of the forms, } $/\text{ft}^2 = 3.50$

8.2 Primary Coolant System

The primary coolant system consists of pressure tubes, insulating liners, inner housing tubes within the pressure tube, pressure tube hardware and extensions, plenum chambers, main piping, pumps, motors, and steam generators. In subsequent sections, expressions are given for the equipment cost, the D_2O inventory, and the pressure drop for the 300-, 500-, and 1000-MWe reactor plants.

8.2.1 Pressure Tubes

The pressure tube material may consist of either sintered aluminum product (SAP) or zirconium-niobium alloy pressure tubes to which stainless steel extensions are connected. The zirconium-alloy tubes are joined to a stainless steel transition joint by a metallurgical bond. This transition joint is then welded to the stainless steel extension, which in turn, is connected by pigtails to the coolant distributors.

The cost of the zirconium-niobium tubes, PT, is given in terms of the weight of the tubes, the cost of the metallurgical bond and welding, and the weight of the stainless steel fittings. The cost relation is

$$PT = (d_{opt}^{2} - d_{ipt}^{2}) \frac{\pi}{4} (h_{c} + 2t_{ar}) \rho_{2} c_{12} n_{f} + 2n_{f} (d_{opt} c_{13} + c_{14})$$
$$+ n_{f} (d_{opt}^{2} - d_{ipt}^{2}) \frac{\pi}{4} (t_{ts} + t_{bs} + t_{2}) \rho_{1} c_{15}$$

where

dopt, dipt = OD and ID of the pressure tube, in.

 h_c = height of the reactor core, in.

tar = axial reflector thickness, in.

 $n_f = number of fuel positions$

tts, tbs = thickness of top and bottom shields, in.

 ρ_1 = density of stainless steel, lb/in³

 ρ_2 = density of zirconium-niobium, lb/in³

 $C_{12} = cost of the zirconium-niobium, $/1b = 50$

C₁₃ = cost of the metallurgical bond and welding, \$/in. of dia. = 75

 $C_{14} = cost$ of the metallurgical bond and welding, \$/tube = 350

t₂ = length of the stainless steel fitting, in.

 $C_{15} = cost$ of the stainless steel fitting, \$/lb = 5

The pressure tubes of sintered aluminum product (SAP) are connected to SAP end fittings by flash welding or some other bonding method. The end fittings are machined for mechanical joint with the plenum tubes. The cost of the tube is given in terms of the weight of SAP, the cost of fittings and installation, and a cost for shop and field tooling, etc. The cost relation is

$$PT = \left[\left(d_{\text{opt}}^2 - d_{\text{ipt}}^2 \right) \frac{\pi}{4} \left(h_c + 2t_{\text{ar}} + t_{\text{ts}} + t_{\text{bs}} + t_{\text{2}} \right) \rho_s c_{16} n_f \right] + n_f (50d_{\text{opt}} + 175) + c_{17}$$

where

dopt, dipt = OD and ID of the pressure tube, in.

h_c = height of the reactor core, in.

 t_{ar} = axial reflector thickness, in.

 n_{f} = number of fuel positions

 t_{ts} , t_{bs} = thickness of top and bottom shields, in.

 $\rho_{\rm s}$ = density of SAP, lb/in³ = 0.098

C₁₆ = cost of the SAP tube including testing, etc,

\$/1b = 8.0

 $C_{17} = cost$ for shop and field tooling, \$35,000

8.2.2 Pressure Tube Hardware and Extensions

The pressure tube hardware and extensions include access plugs, shield plugs, fuel extension fittings, fuel supports, hold-down mechanisms, etc. The costs of the various pieces of the hardware were obtained in terms of the weight of the hardware and the perimeter of the tube plus a constant cost. The cost of the hardware for the SAP pressure tube is:

$$PTH = n_{f} \left[C_{1s} d_{ipt}^{2} + C_{1s} d_{ipt} + C_{2o} \right]$$

where

 n_{f} = number of fuel positions

d_{ipt} = ID of the pressure tube, in.

 C_{18} = unit cost, $$/in^2 = 6.0$

 C_{19} = unit cost, \$/in. = 27

 $C_{20} = constant cost, 125

For the zirconium pressure tube, the expression for the cost of the pressure tube hardware is similar to the above expression with unit costs to reflect the more expensive material.

$$PTH = n_f \left[C_{1s} d_{1pt}^2 + C_{1s} d_{1pt} \right] + C_{2o}$$

where

 $C_{18} = \text{unit cost}$, $$/\text{in}^2 = 9.0$

 $C_{19} = unit cost, $/in. = 40$

 $C_{20} = constant cost, 185

The extension of the pressure tube for the SAP tube is a continuation of the SAP tube out of the core to a height about 36 inches above and below the axial shields and the cost of this extension is contained in equation for the pressure tube cost.

For the zirconium pressure tube, the extension consists of a stainless steel sleeve that is welded to the pressure tube assembly. The cost of the extension, PTE, is expressed in terms of the weight where the total weight equals about 5/3 of the weight of the top extension.

PTE =
$$\pi(d_{opt} + t_s)t_4t_5pan_C$$

where

 $d_{opt} = OD$ of the pressure tube, in.

d + t = mean diameter of pressure tube extension

 $t_{3} = 5/16 \text{ in.}$

 t_4 = wall thickness = 3/8 in.

 t_5 = length of extension = 65 in.

 ρ_1 = density of the stainless steel = 0.28 lb/in³

 C_{21} = fabrication and installation cost, \$/1b = 4.0

The organic inventory and the pressure tube extension, I-PTE, include the fluid in the pressure tubes and extension pieces from the outer edge of the axial reflector to the plenum chambers so that

I-PTE =
$$n_f d_{ipt}^2 = \frac{\pi}{4} a_s t_s \frac{\rho_4}{1728}$$

a_a = the fraction of the extension filled with organic = 0.5

ts = combined length of top and bottom extension tubes = 132 in.

ρ₄ = density of coolant at a temperature midway between reactor inlet and outlet temperatures, lb/ft³

The expression for the pressure drop in the pressure tubes outside of the core includes the friction drop along the length of the tubes plus two velocity heads so that

$$\Delta P - PTE = \frac{4f_1t_7a_4W_a^2}{\left(\frac{d_1pt}{48}\right)(2)(32.2)\rho_4^2(d_{1pt})^4} + \frac{2a_4W_a^2}{2(32.2)\rho_4^2(d_{1pt})^4}$$

where

 $f_{1} = friction factor = 0.006$

t₇ = total length of the pressure tube outside of the core = 7 ft

a₄ = conversion constant = 0.0104

 ρ_4 = density of coolant at the temperature midway between the reactor inlet and outlet temperatures, lb/ft³

 W_8 = maximum flow per fuel assembly, lb/hr

8.2.3 Inner Housing Tube and Insulating Liners

For fuel assemblies with an inner housing tube of SAP, the cost expression, IHT, is given by

IHT =
$$\frac{\pi}{4} (d_0^2 - d_1^2)(h_c + 2t_{ar} + t_s) n_f \rho_3 c_{22}$$

where

do,d; = OD and ID of the inner housing tube, in.

h_o = height of the reactor core, in.

tar = thickness of the axial reflector, in.

t_s = length of the inner housing tube above and below the reflectors, in.

 $n_f = number of fuel positions$

 ρ_s = density of SAP, 1b/ft³ = 0.098

 $C_{22} = \text{cost of SAP, } $/1b = 8.0$

One of the pressure tube options includes the use of an insulating liner inside the pressure tube. This liner can be made from SAP or zirconium. The cost of such a liner, INL, is given by

INL =
$$\pi D_1 (h_c + 2t_{ar} + t_{ts} + t_{bs} + t_{g}) n_f t_{10} \rho C_{23}$$

where

 D_{η} = mean diameter of the liner, in.

 t_{ts} , t_{bs} = thickness of the top and bottom shields, in.

 t_9 = length beyond the shield of the line r = 24 in.

 t_{10} = thickness of the liner, in.

 ρ = density of the liner material

C₂₃ = unit cost of the liner material, \$/1b = 8 for SAP; = 50 for zirconium

8.2.4 Plenum Chambers

The inlet and outlet plenum chambers consist of right circular cylinders of carbon steel to which the coolant piping is connected. The cost of the plenum chambers is expressed in terms of the weight of carbon steel, the number of fuel, control, and safety rods and nozzles that are attached to the chambers. The expression for the cost, PLCH, is written so that five terms represent the cost of plates, shells, tubes, nozzles, and constant cost, respectively.

PLCH =
$$2[2(d_c + 24)^2 \frac{\pi}{4} t_{11} \rho_1 C_{24}] + 2[(d_c + 24)\pi t_{12} p_d \frac{(d_c + 24)}{S_d} \rho_1 C_{24}]$$

+ $2[(n_c + n_c) C_{25} + n_c C_{26}] + 2N_1 C_{27} + 2C_{26}$

where

 $d_c + 2^{1/4} = diameter of the plenums, in.$

 t_{11} = thickness of the top and bottom plates = 1 in.

 ρ_{1} = density of carbon steel = 0.28 lb/in³

 C_{24} = material and fabrication cost = \$1.5/lb

 t_{12} = depth of the plenum chambers = 24 in.

pd = design pressure of the primary coolant system, psi

 n_f, n_c, n_s = number of fuel, control, and safety rod positions

C25 = unit cost for the fuel and control cluster tubes, \$/assembly

Cos = unit cost for the safety rod tubes, \$ tube

 N_1 = number of primary coolant loops

= 4 (300 and 500 MWe)

= 8 (1000 MWe)

 C_{27} = unit cost of the nozzles = \$3,500

 $C_{28} = constant cost = $30,000$

The organic inventory in the plenum chambers is given by

I-PLCH =
$$2 \frac{\pi}{4} (d_c + 24)^2 \frac{t_{12} \overline{\rho}}{1728}$$

The pressure drop through the plenums is based on a combination of empirical and theoretical considerations and is given by

$$\Delta P-PLCH = \frac{(1.9 \times 10^{-11})(W_1^2)(n_f + n_c)^{0.5}}{\overline{\rho}^2(1_s - d_{opt} - 0.75)^2} + \frac{(1.6 \times 10^{-10})(W_1^2)}{\overline{\rho}^2}$$

where

P-PLCH = pressure drop through one plenum, ft

 $W_1 = flow per loop, lb/hour$

 $\overline{\rho}$ = density of coolant in the plenum chamber, lb/ft³

1_s = lattice spacing, in.

 d_{opt} + 0.75 = OD of the fuel tube inside of the plenum, in.

8.2.5 Primary Coolant Piping

The primary coolant piping consists of carbon steel piping, fittings, valves, steam tracing, and thermal insulation. The pressure rating on the valve and flanges is 300 psi and schedule 20 pipe was assumed for the main piping.

The diameter of the piping is optimized within the computer program by computing the annual costs associated with (a) the construction cost of the piping, (b) the organic inventory, and (c) the pressure

drop through the piping. These costs are computed for seven pipe sizes covering a sevenfold range of flow velocities from approximately 45 to 6 feet per second. The optimum pipe size is then chosen to be that which produces the lowest annual cost.

The cost of the piping is given in the table below:

Pipe Size,	Capital	Cost of P	iping, \$
in.	300 MWe	500 MWe	1000 MWe
16	320,000	350,000	800,000
18	360,000	400,000	900,000
20	410,000	450,000	1,050,000
24	480,000	530,000	1,200,000
30	580,000	640 , 000	1,450,000
36	710,000	780,000	1,950,000
42	860,000	950,000	2,350,000

The annual costs associated with the organic inventory are given by the following equation:

$$fyr = C_0I_p(C_n + Y)$$

where

 $C_0 = cost of organic = 0.17 $/lb$

 I_n = inventory of organic in the piping, lb

 C_n = fixed charges on nondepreciable investment

Y = fraction of organic lost per year by decomposition

The inventory in the pipes is given in the table below for the three reactor sizes.

Pipe Size,	Organic				
in.	Inventory, 1b				
16	1.29 α ρ4				
18	1.65 α ρ4				
20	2.02 α ρ4				
24	2.95 α ρ4				
30	4.59 α ρ4				
36	6.68 α ρ4				
42	9.06 α ρ4				

where

 α = equivalent length of pipe (788, 866, and 1970 ft for the 300-, 500-, and 1000-MWe plants, respectively)

 ρ_4 = average organic density in coolant systems, lb/ft³

The pressure drop, ΔP_f , due to frictional loss in the piping is given by the following empirical expression, which takes into account the effect of the roughness to diameter ratio on the friction factor.

$$\Delta P_{f} = \frac{2.39 \ 10^{-11} LW_{1}^{2}}{\rho_{4}^{2} D^{5.1}}$$

where

L = applicable length of the pipe = 208, 230, 310 ft for the 300-, 500-, and 1000-MWe systems

 $W_1 = flow per pipe, lb/hr$

 ρ_4 = average organic density, lb/ft³

D = inside diameter of pipe, ft

Expansion and contraction losses equivalent to 9.5 velocity heads are produced by fittings, valves, entrance, and exit losses to the reactor, superheater, boilers, and economizers. Therefore, the total head loss in pipe and fittings is expressed by the following equation:

$$\Delta P = \frac{2.39 \ 10^{-11} LW_1^2}{\rho_A^2 D^{5.1}} + \frac{1.84 \ 10^{-8} W_1^2}{\rho_D^2 D^4}$$

For the optimization of the pipe size, the pumping power, BHP, is expressed by the following equation assuming \$5% pump efficiency:

BHP =
$$\frac{N_1W_1\Delta P}{(550)(3600)(0.85)}$$

where

N = number of loops

= 4 for 300- and 500-MWe plants

= 8 for the 1000-MWe plant

Thus, the annual cost of pumping through the pipes and fittings is equal to $C_{\rm h}{\rm BHP}$.

The incremental cost of pumping the organic coolant $C_{\rm b}$, is made up of three components: (a) incremental cost of pumps, motors, and backup facilities, (b) cost of plant facilities to produce incremental power, and (c) the fuel cycle cost for the incremental power. The values assumed for each of these three components are \$56/bhp for the pump and \$50/bhp for the motor and backup. The incremental cost of

plant facilities to produce incremental power is \$78/bhp, equivalent to \$100 per electrical kw. At a fuel cycle cost of 1.5 mills/kwh, the fuel cycle component is equivalent to \$8.25/bhp-yr. Thus,

$$C_{h} = C_{d}(106 + 78) + 8.25$$

where

C_d = annual charge on depreciable investment

8.2.6 Pumps and Motors

The primary coolant pumps and motors include carbon steel centrifugal pumps, their bases, flywheels, motors, and electrical auxiliaries. An empirical expression for the pump costs was derived from a combination of theory and available price quotations. The cost of the motors is expressed in terms of the cost per hp. The combined cost for the pumps and motors, PCPM, is given by the expression below where the first term applies to the cost of the motors, and the following two terms are associated with the costs of the pump.

$$PCPM = \frac{C_{29}N_{1}W_{1}^{\Delta H}T}{(550)(3600)(0.85)} + C_{30}(P_{d}^{*})^{\circ \cdot e} \left(\frac{0.124 W_{1}}{\rho_{5}}\right) + C_{31}$$

where

 $C_{29} = cost of the motors, $/ehp = 35$

 N_1 = number of primary coolant loops (motors)

 W_1 = coolant flow per loop, lb/hr

 ΔH_{η} = total head loss in the system, ft

 C_{so} = unit cost of the pumps, \$13.50

 P_d = design pressure of the reactor system, psig

 $\rho_{\rm 5}$ = organic density at the reactor inlet temperature, lb/ft³

 $C_{31} = fixed cost = $40,000$

The organic inventory in the pumps, I-PCPM, was assumed proportional to the pump capacity as given by the following expression:

$$I-PCPM = N_1(0.124 W_1)a_5$$

where

 a_5 = pump volume per unit pump capacity, $ft^3/gpm = 1.1 \times 10^{-3}$

8.2.7 Steam Generators

The design parameters of the steam generator complex are automatically optimized within the code for each computer run. The details of this optimization are described in Section 11.

Connected to each loop of the reactor system is a superheater, two boilers, and an economizer. The superheater is a horizontal U-tube heat exchanger with organic on the shell side. Carbon steel tubes, 5/8 in. x 16 BWG are used and a coolant design pressure of 300 psig is assumed for the shell design. The boiler units are vertical U-tube heat exchangers with organic coolant in the tubes. Carbon steel tubes, 5/8 in. OD x 14 BWG, are used with steam on the shell side. As in the superheater, the design pressure of the organic is assumed to be 300 psig. The economizer consists of a horizontal U-tube heat exchanger with carbon steel 5/8 in. OD x 16 BWG tubes. The organic coolant with an assumed design pressure of 300 psig is on the shell side of the unit.

An empirical relation has been developed for the unit cost of these heat exchanger units in terms of the total area per shell, the total length of each U-tube, and the steam pressure developed in the boiler. This unit cost, \$/ft², includes the costs of the tube material, connection of the tubes to the tube sheath, tube sheath materials, tube sheath fabrication, shell fabrication, moisture separation equipment, assembly and handling, and field work. Listed below are the expressions for the unit cost of the superheater, boiler, and economizer, respectively.

$$CSH = 10.4 \frac{0.27 \text{ A}_{8}^{0.5}}{\ell^{1.5}} + \frac{55.8}{\ell} + \frac{0.0283 \text{ p}_{8}^{0.5} \text{ A}_{8}^{0.5}}{\ell^{1.5}} + \frac{11.2^{0.5}}{\ell^{1.5}} + \beta_{1} + \frac{23,000}{A_{8}} + \frac{11.5}{\ell^{1.5}} + \beta_{2} + \frac{0.00061 \text{ p}_{8} \text{ A}_{8}^{0.5}}{\ell^{1.5}} + \beta_{2} + \frac{35,000}{A_{8}} + \frac{0.078 \text{ p}_{8}}{\ell} + 0.0039 \text{ p}_{8}$$

$$CEC = CSH$$

$$\beta_{1} = 0.075 (\ell - 30) \ell > 30$$

$$\beta_{2} = 0.10 (\ell - 30) \ell > 30$$

$$\beta_{1} = \beta_{2} = 0 \qquad \ell \leq 30$$

 A_s = required heat exchange area, ft^2

 ℓ = total length of each U-tube, ft

p = steam pressure in the boiler, psig

The above parameters are optimized in the steam generator optimization portion of the program described in Section 11.

8.3 Reactor Tank

The reactor tank consists of a calandria tank in which the pressure tubes are mechanically independent from the moderator tank. For the calandria tank the tube sheaths and shell are made of aluminum, and the cost of the tank was determined from the number of tube connections and the weight of the material in the tube sheaths, shell, and tubes. The cost expression, CAL, is given by

$$\begin{aligned} \text{CAL} &= \left[2 \left(d_{c} + 2 t_{r} \right)^{2} \frac{\pi}{4} \left(2 \right) \left(c_{34} \right) \right] \\ &+ \left[\left(d_{c} + 2 t_{r} \right) \pi \left(h_{c} + t_{ar} \right) \rho_{e} c_{35} \right] \\ &+ \left[\left(n_{s} + n_{c} \right) \left(d_{opt} + 0.75 \right) \left(h_{c} + 2 t_{ar} \right) \pi t_{r} \rho_{e} c_{3e} \right] \\ &+ \left\{ 2 \left(n_{f} + n_{c} \right) \left[c_{37} + c_{38} \left(d_{opt} + 0.75 \right) \right] \right\} \end{aligned}$$

where

d = diameter of the core, in.

tr = radial reflector, in.

h_c = height of the reactor core, in.

tar = axial reflector thickness, in.

dont = diameter of the pressure tube, in.

 n_f, n_c = number of fuel and control positions

 t_{13} = thickness of the calandria tube = 0.050 in.

 $\rho_{\rm g}$ = density of the aluminum = 0.098 lb/in³

 C_{34} , C_{35} , C_{36} = unit costs of the tube sheet, shell, and tubes, \$\\$/1b = 3.50, 3.50, and 2.00

 $C_{37} = cost per connection, $/tube = 75$

 C_{38} = connection cost, \$/in. of diameter = 25

8.4 Moderator and Shield Cooling Systems

The moderator system consists of two loops, each containing a heat exchanger, a storage tank, and the associated pumps and piping. The design of this system for the organic-cooled D_2 0 reactor is similar to that for the liquid D_2 0-cooled reactor as described in DP-707⁽¹⁾.

8.4.1 Moderator Heat Exchanger

The cost of the heat exchanger is given in terms of the required heat transfer area. In the calculation of the required heat transfer area, the $\rm D_2O$ velocity in the tubes is assumed to be 40 ft/sec, the outlet temperature of moderator to be 190°F (87.8°C), and the inlet temperature of the $\rm H_2O$ to be 75°F (24°C). The inlet temperature of the moderator, $\rm T_1$, is given by

$$T_1 = 2\overline{T} - 190$$

where \overline{T} is the average temperature of the moderators and the outlet temperature of the H_2O cooling water. The outlet temperature of the H_2O cooling water, T_O , is given by

$$T_{o} = T_{i} - 10$$

or 140°F, whichever is smaller.

Also, the over-all heat transfer coefficient, U, was assumed to be 300 Btu/(hr)(ft^2)(^{O}F). The required heat transfer area, A, is then computed from the equation,

$$A = p_m \frac{(3.413)(10^8)}{U \theta_m}$$

where

$$\theta_{\rm m} = \frac{(190 - t_{\rm o}) - (T_{\rm i} - 75)}{(190 - t_{\rm o})} = \begin{array}{c} \log \text{ mean temperature difference} \\ \ln \overline{(T_{\rm i} - 75)} \end{array}$$

 p_{m} = power to the moderator, MW

The cost of the heat exchangers, MDHX, is then given by

$$MDHX = C_{39}A + C_{40}$$

where

 $C_{39} = \text{unit cost}, \$/\text{ft}^2 = 15.0$

C₄₀ = constant cost that is applicable to the entire moderator cooling system, \$50,000

8.4.2 Moderator Piping

The cost of the moderator piping, MDPP, is expressed in terms of the weight of the steel in the piping as follows:

MDPP =
$$2C_{41} \left[0.101 \left(\frac{f_m}{2} \right)^{1/2} + 2t_{14} \right] \pi \rho_1 t_{14} L_1$$

where

 $f_m = moderator flow rate, gpm$

 L_1 = total length of moderator piping, in. = 1200, 1800, and 2400 for 300-, 500-, and 1000-MWe plants

 t_{14} = wall thickness of piping, in. = 0.25

 ρ_1 = density of steel, lb/in³

 $C_{41} = unit cost, $/1b = 7.00$

The flow rate, f_m , is

$$f_{\rm m} = \frac{6.27(10^3)}{380 - 2 \, \overline{\rm T}} \, p_{\rm m}$$

8.4.3 Moderator Pumps and Motors

The cost of the moderator pumps, MDPM, is given in terms of the required horsepower for the pumps and motors and the flow rate in the system.

$$MDPM = \frac{C_{42} f_{m}^{\Delta P_{1} \rho_{7}}}{a_{6} a_{7}} + f_{m} C_{43} + C_{44}$$

 C_{42} = unit cost, \$/1b = 15.0

 C_{43} = unit cost, \$/gpm = 2.0

 $C_{44} = constant, 3150

 ρ_7 = density of D₂O, lb/gal

 $a_s = pump efficiency = 0.85$

 $a_7 = conversion factor = 33,000$

 ΔP_1 = pressure drop in the moderator system, ft

The pressure drop is obtained by the following equation:

$$\Delta P_{1} = \frac{4a_{8}I_{2}(1600)}{a_{9}\left(\frac{f_{m}}{2}\right)^{1/2} + N_{1}\left(\frac{1600}{64}\right)}$$

where

 $a_e = friction factor = 0.003$

L₂ = equivalent length of piping in one of the moderator loops, ft = 100

 $a_o = conversion factor = 0.101/12$

 N_1 = number of velocity heads

8.4.4 D₂O Inventory

The D_2 0 inventory in the moderator cooling system is computed from the volume of the heat exchanger and the piping by assuming a fluid velocity of 40 ft/sec in the piping and a 1/2-inch diameter for the heat exchanger tubes. The expression for the inventory, I-MODS, is then:

I-MODS =
$$\frac{\pi}{4} \left[(0.101)^2 \frac{f_m}{2} \right] L_1 \rho_7^! + 18 \rho_7^! A$$

where

 $A = heat transfer area, ft^2$

 ρ_{x}^{1} = density of D₂O, lb/in³

 L_1 = total length of moderator piping, in. = 1200, 1800, and 2400 for 300-, 500-, and 1000-MWe plants

8.4.5 Storage Tanks

The cost of the moderator storage tanks, NDST, is given in terms of the $\rm D_2O$ inventory in the moderator, $\rm I_m$, as follows:

$$MDST = C_{45}I_{m} + C_{46}$$

where

 $C_{45} = \text{unit cost, } \$/\text{lb} = 0.114$ $C_{48} = \text{constant, } \1000

8.4.6 Shield Cooling System

The shield cooling system consists of an H₂O circulating system for removing the heat from the shields. This system consists of a pump, cooler, surge tank, and stainless steel piping. The cost of the shield cooling system, SCS-C, is expressed as a function of the shield heat load plus a constant.

$$SCS-C = C_{47}Q_{rs}^{0.6} + C_{48}$$

where

 Q_{rs} = heat load on the radial, top and bottom shields, Btu/hr

 $C_{47} = constant = 6.2$

 $C_{48} = constant cost, $45,000$

8.5 Control and Safety Rods

The control rods are clusters of individual rods that are top mounted, mechanically actuated rods, and are positioned on the lattice positions. The system includes clusters of individual rods, control rod drives, thimbles, controls, and cooling facilities. The cost of the various items has been broken down so that the cost of the system is expressed as a function of the number of individual rods and the rod length. The equation for the cost of control rods, CR, is

$$CR = a_{10} c_{10} [C_{51} + C_{52}/(h_{c} + 2t_{ar})] + C_{53}$$

where

a, = number of control rods per control position

 C_{51} = control rod cost, \$/rod = 11,500

 C_{52} = control rod cost, \$/ft = 28

 $C_{53} = fixed cost = $50,000$

n = number of control rod positions

h = height of the reactor core, in.

 t_{pr} = axial reflector thickness, in.

The safety rods are also top mounted and placed in interstitial lattice positions. They are mechanically driven with gravity fall. The cost, SR, is expressed as a function of the number of rods and the length of the rods as follows:

$$SR = n_s[C_{54} + C_{55}/(h_c + 2t_{ar})] + C_{56}$$

where

SR = cost of the safety rod system, \$

ns = number of safety rod positions

 C_{54} = safety rod cost, \$/rod = 8,500

 C_{55} = safety rod cost, ft = 25

 $C_{56} =$ fixed cost, \$30,000

8.6 Instrumentation and Monitoring

The coolant monitoring instrumentation consists of the devices for measuring the flow, temperature, and radioactivity in each of the coolant outlet pipes. The cost of such a system is expressed as the cost per fuel position plus a fixed cost.

$$CMI = n_{f}C + C_{60}$$

where

 $n_{\mathbf{f}}$ = number of fuel positions

 $C_{sq} = unit cost, $/position = 3,380$

 $C_{so} = fixed cost, $285,000$

The nuclear instrumentation consists of two startup channels, two log n - period channels, three flux level safety channels, and one linear level control channel. Also, an allowance has been made for internal flux and temperature instrumentation. The cost of such a system is estimated at \$100,000.

The instrumentation for the primary cooling system includes pressure and temperature measuring facilities throughout the cooling circuits. Also, a level measurement and control, pressurizer, remote controls for the primary valves and pumps, and a central control room facility are included. The cost of this instrumentation is assumed to be constant and equal to about \$600,000. The functional requirements of these instruments are similar to those for the D₂O liquid-cooled system⁽¹⁾ and the costs are assumed to be increased arbitrarily about 50% for the organic because of the necessity for tracing the sensing leads and providing a barrier between the sensing and receiving instruments.

8.7 Reactor Enclosure and Fuel Charging Equipment

The reactor enclosure and support is a concrete "silo" extending above and below the reactor and is similar to the structure described for the liquid-cooled case given in DP-707⁽¹⁾. The cost of this structure, RE, is expressed in terms of the volume of concrete, the surface area of the forms, and the mass of the reinforcing steel.

$$RE = (d_c + 2t_r + 2t_{rs} + 2t_s)\pi t_{16} \left[\frac{t_{15}C_{e3}}{(36)^3} + \frac{2(a_{11}C_{e4} + C_{e5})}{144} \right]$$

where

d_c = diameter of the reactor core, in.

 $t_n = radial reflector thickness, in.$

trs = thickness of the radial thermal shield, in.

ts = thickness of the biological shield, in.

 t_{15} = average thickness of the concrete, in.

 t_{16} = height of enclosure, in.

 $C_{63} = cost of the concrete, $/yd^3 = 20$

 a_{11} = amount of reinforcing steel, lb/ft^2 = 4

 $C_{64} = cost of reinforcing steel, $/1b = 0.15$

 $C_{65} = cost$ of the forms, $f^2 = 2.25$

Thermal insulation is placed on the inner walls of the rooms containing the pigtails and the headers. The cost of this insulation, TI, is expressed in terms of the area of the walls as follows:

$$TI = \frac{\pi}{144} \left(d_c + 2t_r + 2t_{17} \right) \left(2t_{18} + d_c + 2t_r + 2t_{17} \right) C_{66}$$

where

t, = room radius minus the reactor radius, in.

 $t_{1B} = room height, ft$

 C_{ee} = installed cost, ft^2 = 3.50

The fuel charging equipment includes the machinery and controls required to transfer fuel and other components into and out of the reactor while it is shut down. It does not include the facilities involved in moving fuel from the reactor building to the storage basin. The cost of such machinery is estimated to be \$1.1, \$1.3, and \$1.6 x 10^6 for 300-, 500-, and 1000-MWe systems.

TABLE 8.1

COEFFICIENTS IN SHIELD EQUATIONS								
1 0 <u>J</u> 0	0	2	0	1	2	0 2	2	5
a _{ij} 27.0	-6.92	0.240	-0.394	0.0259	-0.00111	0.0483	-0.00294	5.05x10 ⁻⁵
b _{ij} 0.629	-0.0170	1.516x10 ⁻⁴	-5.39x10 ⁻³	3.34x10 ⁻⁵	5.29x10 ⁻⁷	1.30x10 ⁻⁵	6.33x10 ⁻⁷	-1.19x10 ⁻⁸
c _{ij} -132.3	9.004	-0.00705	-0,932	-0.0244	6.13x10 ⁻⁴	7.46x10 ^{-s}	-1.58x10 ⁻⁴	-3.46x10 ⁻⁶
d ₁ j 45.85	-4.207	0.1989	-2.452	0.1607	-0.00426	0.0343	-0.00269	5.96x10 ⁻⁵
e _{1J} 0.632	-0.0170	1.516x10 ⁻⁴	-5.39x10 ⁻³	3.34x10 ⁻⁵	5.29x10 ⁻⁷	1.30x10 ⁻⁵	6.33x10 ⁻⁷	-1.19x10 ⁻⁸
$ e_{ij} = 0.632 -0.0170 -0.0170 -0.0174 -0.00000000000000000000000000000000000$								

9. Reactor Building Structures and Auxiliary Reactor Systems

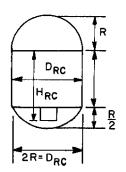
9.1 Containment Structures

The reactor containment building consists of a carbon steel cylinder with a hemispherical dome and hemiellipsoidal bottom, and is designed to completely contain a spill equivalent to the inventory in the reactor and one primary loop together with the secondary $\rm H_2O$ in one steam generator complex. Preliminary plant arrangements showed that a minimum size structure is governed by the space required for equipment, rather than by the pressure buildup requirements. A minimum thickness for the dome of 0.5 inch was established for the building based on structural stability, and similarly, a thickness of 0.625 inch was stipulated for the cylindrical wall section. Numerous examples of hypothetical organic and $\rm H_2O$ releases into the free volume of the reactor building were examined and were found to be consistent with the above criteria for determining the size of the containment building $^{(14,15)}$. None of the conditions were shown to exceed the maximum allowable pressure for these minimum wall thicknesses.

The building dimensions determined in accordance with the space requirement for equipment were coupled with appropriate unit costs to yield total building costs including the steel vessel, substructure, external treatment, shadow shielding, and all internal structures. The procedures for computing these costs are given in the following paragraphs.

9.1.1 Containment Vessel

The cost of the reactor containment vessel includes the cost of the containment shell including air locks, equipment hatches, and the cost of erection and testing. The height, $H_{\rm RC}$, and the radius, $R_{\rm RC}$, for the reactor building are shown schematically in the sketch below. The cost of the containment building, CTV, is given by the following expressions.



CTV = (Vessel weight)(
$$C_{1}^{t}$$
) + C_{2}^{t}

Vessel weight = (1.19 $^{4}R_{RC}^{2}$ + $2\pi R_{RC}^{2}H_{RC}$) $\rho_{1}\frac{t_{W}}{12}$ + $2\pi R_{RC}^{2}\rho_{1}\frac{t_{d}}{12}$

$$R_{RC} = \sqrt{2}(\frac{D_{R}}{2} + t_{s} + L_{1} + r_{s} + 32)$$

$$H_{RC} = (\frac{R_{RC}}{2} + h_{s} + 20)$$

Dp = diameter of reactor and radial reflector, ft

ts = thickness of the biological shield, ft

L, = center distance between the primary pumps and boiler, ft

 $r_{\rm g}$ = radius of the boiler shell, ft

R_{RC} = containment building radius, ft

 $h_{\rm g}$ = over-all height of the boiler, ft

 H_{RC} = height of the containment vessel, ft

 ρ_1 = density of steel, lb/ft³

 t_{w} = containment vessel wall thickness = 0.625 in.

t_d = containment vessel dome thickness = 0.5 in.

 $C_1' = unit cost, $/1b = 0.40$

 $C_2' = constant cost, $100,000$

9.1.2 Containment Vessel Substructure

The cost of the containment vessel substructure includes the cost of excavation, backfill, and below-grade surface treatment for the containment vessel. The cost, CTVS, is expressed in terms of the volume of the excavation, volume of the concrete fill, and the surface volume of the bottom head.

CTVS =
$$C_3^{'} \frac{\pi}{3} \frac{(R_{RC} + 4)^3}{27} + C_4^{'} \frac{\pi}{3} \frac{(R_{RC} + 4)^3}{27} - R_{RC}^3 + C_5^{'}(4.336R_{RC}^2)$$

where

 $C_3^{\dagger} = \text{cost of excavation} = $20/yd^3$

 $C_4' = \text{cost of fill} = $40/\text{yd}^3$

 $C_5^1 = \text{cost of surface treatment} = \$0.2/\text{ft}^2$

9.1.3 Containment Vessel External Treatment

The cost of the containment vessel external treatment, CTVE, includes the cost of the external insulation and treatment of the containment vessel and is expressed in terms of the surface area of the vessel.

CTVE =
$$2\pi R_{RC}C'_{e}\left(\frac{R_{RC}}{2} + 4 + H_{RC}\right)$$

where

 $C_8^t = \text{external treatment cost} = \$3.0/\text{ft}^2$

9.1.4 Shadow Shielding

Concrete shadow shielding 2 ft thick along the side walls and 1 ft thick along the top head is provided on the inside surface of the containment vessel above grade. The cost of this shielding, CTSS, is expressed in terms of the volume of the concrete as follows:

CTSS =
$$\frac{C_z^{\prime}}{27} \left[2\pi (R_{RC} - 0.5)^2 (1.0) + 4\pi (H_{RC} - \frac{R_{RC}}{2}) (R_{RC} - 1) \right]$$

where

 C_7^{\dagger} = unit cost of concrete, $\$/yd^3 = 80$

9.1.5 <u>Internal Structures</u>

The internal structures, that is, structures that are inside the containment vessel, consist of four concrete floors and miscellaneous iron and steel structures exclusive of the shadow shields and the reactor biological shield. The cost of these structures, INT, is expressed in terms of the volume of concrete.

INT =
$$C_8^{\dagger}V_{1c} + C_9^{\dagger}$$

where

$$V_{ic} = \frac{1}{27} [64(L_1 + r_s + 22)(h_s + 20) + 40(\frac{D_R}{2} + t_s)(h_s + 28) + 2(2R_{RC} - 4 - \frac{D_R}{2} - t_s) + 16(\frac{D_R}{2} + t_s + L_1 + r_s + 22)(L_1 + r_s + 22)]$$

 $C_8^1 = \text{cost of concrete}, \$/yd^8 = 75$

 $C_9^1 = \text{constant cost} = \$750,000, \$980,000, and \$1,430,000 for the 300-, 500-, and 1000-MWe plants, respectively$

where

L₁ = centerline distance between the primary pumps and the boiler, ft

 r_s = radius of the boiler shell, ft

 R_{RC} = radius of the containment building, ft

 h_s = over-all height of the boiler, ft

 D_{R} = diameter of the reactor and reflector, ft

ts = thickness of the biological shield, ft

9.2 Other Plant Structures

9.2.1 Land and Land Rights

The cost of land and land rights has been based on the AEC standard site criteria and a value of 1,200 acres at \$300/acre has been used to give a total of \$360,000.

9.2.2 Access Roads and Improvements

The costs of permanent access roads, general site improvements, and rail interconnections are assumed to be \$480,000, \$510,000, and \$550,000 for the 300-, 500-, and 1000-MWe plants, respectively.

9.2.3 Fuel Handling Building

The costs of the fuel handling structure and equipment for new and spent fuel that is located external to the reactor containment building are \$1,421,000, \$1,600,000, and \$2,200,000 for the 300-, 500-, and 1000-MWe plants, respectively.

9.2.4 Reactor Building Crane

The cost of the reactor building crane, RBC, is expressed as follows:

$$RBC = C_{12}^{!} \frac{(2R_{RC} - L_{2})}{12} + c_{13}^{!}$$

where

 C_{12}^{t} = unit cost of the crane, \$/ft of span = 100

 $C_{12}^{\dagger} = constant cost = $100,000$

L₂ = over-all clearance between the bridge span and the containment vessel, in.

9.2.5 Miscellaneous Structures

The costs of miscellaneous structures, including the gatehouse, warehouse, and oil pumphouse, are assumed to cost \$190,000, \$265,000, and \$470,000 for the 300-, 500-, and 1000-MWe plants, respectively. This cost item has been combined with "miscellaneous systems" described in Section 9.3.

9.3 Coolant System Auxiliaries

9.3.1 Coolant Makeup System

This system includes the equipment for the transfer of coolant from storage to maintain the operating level of the organic in the primary systems. The costs assumed for this system were \$20,000, \$32,000, and \$55,000 for the 300-, 500-, and 1000-MWe reactor plants, respectively.

9.3.2 Coolant Purification System

This system includes the equipment required to remove the high boilers that are formed in the organic coolant during operation. The system consists of a flash distillation column, heaters, condensers, pumps, and storage tanks. All of the new coolant enters the primary system through the purification system. The cost of this system is assumed to be proportional to the capacity of the heaters for the flash distillation column. The flow through the purification system, g, is given by

$$g = 100 \frac{H_B}{H^0} + H_B$$
, 1b/hr (1)

H_B = high boiler formation rate, lb/hr

H° = equilibrium high boiler concentration, %

The capacity of the heater for the column, ph, is given by

$$p_{h} = \frac{gC_{p}\Delta T_{p}}{3413}, kw$$
 (2)

where

 $C_n = \text{specific heat of the organic, } Btu/(lb)(|^{O}F)$

 $\Delta T_{\rm p}$ = temperature rise across the heater, $^{\rm o} F$

The cost of the system, CPS, is given by

$$CPS = C_{14}^{\dagger} P_{h} + C_{15}^{\dagger}$$
 (3)

where

 C_{14}^{\dagger} = unit cost for the column heater = \$25/kw

 $C_{15}^{1} = \text{constant cost} = \$17,300, \$23,000, \text{ and } \$36,000 \text{ for the } 300-, 500-, \text{ and } 1000-\text{MWe plants, respectively}$

9.3.3 Coolant Storage Tanks, Vents, and Drains

The system includes the tanks and piping for storage of the primary coolant when drained from the system. The cost of this system, CST, is given by

$$CST = C_{1e}^{\dagger} I_p + C_{17}^{\dagger} \tag{4}$$

where

In = coolant inventory in the primary system, gal

 $C_{18}^{t} = \text{unit cost} = \$0.5/\text{gal}$

 C_{17}^{\dagger} = constant cost = \$65,000, \$88,000, and \$135,000 for the 300-, 500-, and 1000-MWe plants, respectively

9.3.4 Coolant Particulate Removal System

Included in this item is a system of precoat filters and the auxiliaries that are required to remove the corrosion and erosion products from the primary coolant. The cost of the system is assumed to be directly proportional to the total area of the precoat filters. The filtration system is designed to maintain a design quality of about 1 part per million solid impurities in the coolant.

The flow rate through the filtration system, gf, is given by

$$g_f = \frac{100R_f A_g}{7.3E \times 10^{-8}}, gpm$$
 (5)

where

 R_f = corrosion rate of the steam generators heat exchange surface in contact with the organic coolant = 0.05 mg/cm²/mo = 2.38 x 10⁻⁹ lb/(min)(ft²)

As = steam generator heat exchange surface area, ft2

E = removal efficiency for the filtration system = 75%

The system consists of two filters operating at 1/2 capacity with a nominal capacity of 2 gpm/ft². Thus the required filter area is given by

$$A_{T} = \frac{1}{2}g_{f} = \frac{1}{2} \left(\frac{100 \times 2.38 \times 10^{-9}}{7.3 \times 75 \times 10^{-6}} \right) A_{S} = 2.2 \times 10^{-4} A_{S}$$
 (6)

The cost of the system, CPRS, is given by

$$CPRS = C_{18}^{'}A_{T} + C_{19}^{'}$$
 (7)

where

 C_{18}^{\prime} = unit cost of the filters = \$150/ft

 $C_{19}' = \text{constant cost} = \$36,000, \$48,000, \text{ and }\$75,000 \text{ for the }300-,500-, \text{ and }1000-\text{MWe reactor plants, respectively}$

9.3.5 Steam Tracing System

This system consists of 1/2- and 3/8-inch carbon steel steam tracing lines and maintains all the organic systems except the primary loop at a minimum of 375°F. The system uses 800 psig saturated steam. The cost of this system is assumed to equal \$50,000, \$72,000, and \$110,000 for the 300-, 500-, and 1000-MWe plants, respectively.

9.4 Off-Gas and Waste Disposal Systems

9.4.1 D20 Distillation System

The cost of this system includes the cost of the distillation equipment and structures and is assumed to be \$150,000 for a single unit for the 300- and 500-MWe plants and \$310,000 for two such units that would be required for the 1000-MWe plant.

9.4.2 Waste Disposal for Aqueous Systems

This item includes the aqueous waste disposal system, its equipment and structures, and is assumed to be a constant cost equal to \$400,000, \$500,000, and \$800,000 for the 300-, 500-, and 1000-MWe plants.

9.4.3 Waste Disposal for Organic Systems

This system consists of transfer pumps, decay storage tanks, a waste-fired boiler, and flue gas filtering apparatus to dispose of the high boiler organic wastes that are extracted from the coolant in the coolant purification system. The high boilers are discharged to storage tanks for a 6-day holdup after being removed from the coolant. Following this, the product is then burned in a fire-tube boiler which generates 300 psig steam to supply the steam tracing system. An auxiliary oil supply is used to fire the waste-fired boiler when the supply of organic high boilers is insufficient to produce sufficient steam as demanded by the tracing system.

The cost of this system is determined by the high boiler formation rate which equals the coolant makeup rate. The cost of the system is expressed as a function of the volume of the holdup tanks and a constant cost. The volume of the holdup tanks is

$$v_t = \frac{2^4 t_d^H b}{7.5}$$

so that the cost expression for the waste disposal system is given by

$$OWDS = V_t C_{23}^{\dagger} + C_{24}^{\dagger}$$

 t_d = decay time for the high boilers = 6 days

H_b = high boiler formation rate, lb/hr

 C_{23}^{\dagger} = unit cost of the decay tanks = \$1/gal

 C_{24}^{\prime} = constant cost = \$35,000, \$47,000, and \$72,000 for the 300-, 500-, and 1000-MWe plants, respectively

9.4.4 Waste Gas Handling System

This system is required to process the waste gases that are formed as a result of pyrolytic and radiolytic decomposition of the organic. Also, this system will handle any fission product gases that are released in the event of a fuel element failure. The system consists of steam jet ejectors, charcoal adsorbers, waste gas decay tanks, and the necessary piping and instrumentation. The cost of the system is a function of the size of the adsorber vessels and the volume of charcoal adsorbent that is required. The waste gas decay tank consists of two banks of 11 tanks, each 17 ft long with a wall thickness of 1 inch, and with the tank diameter designed to provide the required system capacity. The volume of the decay tanks was based on 7.1 ft³/SCFH of hydrogen gas evolved. Thus, the diameter and the weight of the decay tanks are given by the following

 $d = 1.87\sqrt{F}$ $WDT = 3700\sqrt{F}$

and the cost of the waste gas handling system, WGH, is given by

 $WGH = C_{25}^{1}(3700\sqrt{F}) + C_{26}^{1}(7.1F) + C_{27}^{1}$

where

WDT = weight of the decay tanks, lb

F = gas flow rate, SCFH (hydrogen)

d = adsorber vessel, diameter, in.

 C_{25}^{1} = unit cost of the adsorber vessels \neq \$0.60/lb

 C_{26}^{\dagger} = unit cost of the charcoal adsorbent = \$20/ft³

 C_{27}^{\prime} = constant cost = \$38,000, \$50,000, and \$76,000 for the 300-, 500-, and 1000-MWe reactor plants, respectively

9.4.5 Off-Gas System for the Moderator

This includes the system for venting radiolytic gases that are vented from the moderator systems. The cost of this system is assumed to be constant equal to \$182,000, \$270,000, and \$500,000 for the 300-, 500-, and 1000-MWe reactor plants.

A helium blanket is maintained over the D_20 moderator in the calandria. This blanket serves to collect the dissociated D_20 and other gases which are evolved. The gas mixture is circulated through a catalytic recombiner which is followed by condensation and drying apparatus to recover the D_20 vapor. The noncondensable gases are vented to the waste disposal system.

The estimated cost of this system is \$182,000, \$270,000, and \$500,000 for the 300-, 500-, and 1000-MWe plants, respectively.

9.4.6 Organic Degasification and Pressurizing System

A common system was provided to maintain the operating pressure of the primary loop and to degasify the coolant. Two full-capacity circulating pumps furnish continuous circulation of organic through the system and also serve to maintain reactor coolant pressure.

The primary coolant flows from the reactor to a combination degasifier and surge tank, where the $\rm H_2O$ and noncondensable vapors are removed. This tank has a surge volume equivalent to the volume change that results from a temperature change equal to the difference between the reactor inlet and outlet temperature. The pressurizing pumps are connected to the bottom of the degasifier surge tank and have a capability for compensating for this volume change in a period of two minutes. Larger volume changes in the organic coolant associated with startup, etc., would be accommodated by a separate surge tank.

The cost of this system is determined by the primary coolant system inventory, the coolant temperature difference across the reactor, and the primary system operating pressure. The system cost includes the cost of the tank, the two circulating pumps and motors, and the pipe. The tank weight, TW, is

$$TW = \left[\frac{\pi dht}{12} + \frac{2\pi d^2 t}{(4)(12)}\right] \rho_1$$

where

d = degasifier tank diameter, ft

h = degasifier tank height, ft

 ρ_1 = density of steel, lb/ft³ = 500

t = degasifier tank wall thickness, inches = 1.0

The diameter of the tank is obtained from the surge volume requirement and is given by the expression below, assuming an overall height of 17 ft and a height of 7 ft for the surge volume at the lower coolant temperature

$$d^2 = (2I_c \gamma \Delta T_r) / (5\pi \rho_c)$$

where

 $I_c = primary coolant system inventory, lb$

 γ = volume expansion coefficient for organic, ft³/°C

 ΔT_r = reactor coolant outlet temperature minus the inlet temperature, ${}^{\circ}C$

 ρ_c = density of the organic coolant, lb/ft³

The cost of the pressurizer pump depends upon the flow rate, which is determined from the makeup rate requirement. Thus,

$$f_1 = \frac{7.48 \text{V}_s}{2}$$

where

 f_1 = pressurizer pump flow rate, gpm

 V_s = surge volume in the surge tank and equals $\frac{I_c \gamma \Delta T_r}{\rho_c}$, ft³

The required brake horsepower for the pumps is

BHP =
$$\frac{(f_1)(\Delta P_p)(144)(\rho_c)}{(0.8)(33,000 \times 7.48)}$$

where

 ΔP_p = primary system operating pressure, psia

The unit costs of the pumps and motors are \$2.0/gpm plus \$1500 for each pump and \$2200/bhp plus \$100 for each motor. Thus, the cost expression is

DEGAS =
$$C'_{28}$$
TW + 2(1600 + 2.0 f_1 + 22BHP) + C'_{29}

where

 C_{28}^{1} = unit cost of the degasifier tank = \$0/4/1b

C'₂₉ = cost of the piping, control, and instrumentation = \$66,000, \$89,000, and \$137,000 for the 300-, 500-, and 1000-Mwe plants, respectively

10. Operating and Maintenance Costs

The cost of operating and maintaining the plant has been included in accordance with the AEC Cost Evaluation Handbook (12). The operating and maintenance costs for the reactor plant include the operating payroll, maintenance, labor and material, supplies, nuclear insurance, D_2 0 losses, and organic makeup. The table below lists the annual costs for the operating payroll, maintenance, labor and materials, and supplies for the 300-, 500-, and 1000-Mwe plants, respectively.

Item	300 MWe	500 MWe	1000 MWe
Operating payroll	\$ 715,000	\$ 800,000	\$ 950 , 000
Maintenance, labor, and material	510,000	650,000	900,000
Supplies	175,000	200,000	280,000
Subtotal	1,400,000	1,650,000	2,130,000

The costs of nuclear insurance, D₂O losses, and organic makeup are given by

NI = 260,000 + 30
$$Q_R$$

DL = $a_1 C_1'' I_M$
OMP = 8760 $C_2'' 1_f H_B$

where

NI = nuclear insurance, \$/yr

 $DL = D_0 O$ losses, $\frac{\$}{yr}$

OMP = organic makeup, \$/yr

 Q_R = reactor thermal power, MW

 $I_M = D_20$ inventory, 1b

 $a_1 = D_20$ loss rate = 0.005 fraction/year

 $C_1'' = cost of D_2O = $20/1b$

H_B = organic coolant makeup rate, lb/hr

l = load factor

 $C_{p}^{"}$ = cost of organic = \$0.17/1b

10.1 Organic Makeup

The degradation of organic coolant results from pyrolytic and radiolytic decomposition, and the resultant high boilers which are formed are then removed by the coolant purification system. The degradation rate is computed from empirical relations that have been developed in connection with organic studies at other sites.

The expression used for the pyrolytic decomposition rate(18) is

$$Y = 87.6 l_p e^{(0.25T - 34.4)}$$

where

Y = fraction of organic lost/year by pyrolytic decomposition

T = average temperature of the coolant in the reactor system, OR

1_f = load factor

The expression used for the radiolytic decomposition rate (17) is

$$HB_{R} = c_{1}P_{CL}(G_{n}E_{n} + G_{\gamma}E_{\gamma}), \quad lb/hr$$

where

P_{CL} = total reactor power, MW

G_n = number of molecules of organic destroyed per 100 ev neutron energy absorbed = 0.3

Gy = number of molecules of organic coolant destroyed per 100 ev gamma energy absorbed = 0.09

 E_n = energy deposited in the coolant by neutrons, MW/MW

E, = energy deposited in the coolant by gammas, MW/MW

 $c_1 = conversion factor = 1.89 \times 10^2$

The energy deposited in the coolant is

$$E_n = 2.12 \times 10^{-5} A_c \overline{\rho}$$

MW/MW

$$E_{\rho} = 1.27 \times 10^{-5} A_{c} \overline{\rho}$$

MW/MW

where

 A_c = area of organic in the fuel assembly, in^2

 $\overline{\rho}$ = average density of organic in the reactor, lb/ft²

11. Steam Generator Optimization

11.1 Method of Optimization

In the optimization of the turbine plant described in Section 12, the throttle pressure, P_t , the throttle temperature, T_t , and the temperature of the final feedwater returning from the turbine plant, T_f , are varied in order to minimize the over-all cost of the plant. For each set of P_t , T_t , and T_f , it is necessary to determine an optimum steam generator design. The steam generator optimization program consists of four blocks, one each for the design of the (a) steam transfer pipe, (b) superheater, (c) boiler, and (d) economizer sections of the steam generator unit. A schematic of the subroutine flow chart is shown in Figure 11.1. (18)

The temperature and pressure profiles in the steam generator are shown in Figure 11.2. (18) As previously noted, the values of the feedwater temperature, T_f , throttle temperature, T_t , and the throttle pressure, T_p , which are used as input in this routine are obtained from the turbine plant optimization.

In the steam generator subroutines the properties of the various fluids, superheated steam, organic, liquid $\rm H_2O$, and saturated steam, are required frequently during the calculations. The following properties are required in the calculations, and side studies were made in order to reduce these functions to table look-ups or curves that could be fitted with polynomials.

Superheated Steam	
Specific volume	v (ť,p)
Viscosity	μ (t,p)
Temperature	t (t,H)
Steam property	ϕ (t,p) = $\frac{k^{0.2}c^{0.33}}{\mu^{0.47}}$
Enthalpy	H (t,p)
Organic	
Density	ρ (t)
Viscosity	μ (t)
Property function	φ (t)
Property	$\lambda (N_{re}) = N_{st} N_{pr}^{2/3}$

where $N_{\mbox{\scriptsize re}},\ N_{\mbox{\scriptsize st}},$ and $N_{\mbox{\scriptsize pr}}$ are the Reynolds, Strouhal, and Prandtl numbers.

Liquid H20

Water property function	φ (t)
Heat capacity	c (t)
Viscosity	μ (t)
Density	ρ (t)

Saturated Steam

Temperature	t (p)
Pressure	p (t)
Enthalpy	H (t)
Enthalpy of vaporization	H _{fg} (t

where t, p, and H are the temperature, pressure, and enthalpy of the fluids.

11.2 Steam Generator Subroutines

11.2.1 <u>Input</u>

The input to the steam generator subroutine comes from the preceding parts of the code and from the turbine optimization routine.

- Pt = steam pressure at the turbine throttle, psia
- T_t = temperature of the steam at the turbine throttle, $^{\circ}C$
- T_f = temperature of the water returning from the final feedwater heater, ${}^{\circ}C$
- T_{O} = outlet temperature of the organic leaving the reactor, ${}^{O}C$
- T_1 = inlet temperature of the organic into the reactor, ${}^{\circ}C$
- M = total power transferred in the steam generators, MW
- N_n = number of primary coolant loops in the reactor complex

11.2.2 Steam Pipe

The steam pipe leading from the steam generator units to the turbine consists of individual leads from the superheaters to a header. A single pipe then leads from headers on either side of the reactor to the turbine plant; the piping then divides into two legs leading into the turbine units.

The equations for the effective length of the three steam pipe leads are:

$$L_p = 17 + 188 d_2$$

$$= 129 + 106 d_0$$

$$= 92 + 50 d_1$$

where

D_D = effective diameter of the single main stream line, ft

 $d_2 = D_p/2$

 $d_o = D_p$

 $d_1 = D_p/\sqrt{2}$

A simplified flow diagram of the steam pipe subroutine is shown in Figure 11.3. The pressure drop is given by

$$\Delta P_{sp} = \alpha (P_{B} - P_{t})$$

where

 P_{R} = boiler pressure, psia

Side studies have shown that α is fairly constant over the range of coolant temperatures of interest and is equal to approximately 0.4.

An initial value for the mass flow rate of G_t is chosen, and an initial value of the diameter of the steam pipes is then given by

$$D_{p} = \sqrt{\frac{\mu_{W}}{G_{+}}}$$

where W is the total flow of steam from the steam generator and is computed from the total heat transferred in the steam generator and the initial and final enthalpies of the secondary fluid. The values of $G_{\rm t}$ and thus $D_{\rm p}$ are systematically adjusted to satisfy the pressure drop equation

$$\Delta P_{\text{pipe}} = \frac{G_{\text{t}}^{2}}{144 \text{ g}} \Delta v + \frac{2v_{\text{av}}}{D_{\text{p}}} f_{\text{p}} L_{\text{p}}$$

where

 Δv = change in specific volume over the length of the steam pipe $v_{\rm av}$ = average specific volume for the steam

and the product $f_p I_p$ for the system of pipes leading from the superheater to the turbine plant is given by the following expression in which the friction factor is taken to be 0.00235 plus the quantity 0.0009 divided by the diameter of the pipe lead.

$$f_{p}L_{p} = (0.00235 + \frac{0.0009}{D_{p}})(129 + 106 D_{p})$$

$$+ (0.00235 + \frac{0.0009}{D_{p}/2})(17 + 92 D_{p})2$$

$$+ (0.00235 + \frac{0.0009}{D_{p}/\sqrt{2}})(92 + 34.7 D_{p})\sqrt{2}$$

The annual cost for the steam pipe $I_{\mbox{\scriptsize sp}}$ is given by the following expression

$$I_{sp} = a_{2}(c_{1}D_{p}t_{w} + c_{2})$$

where

 a_2 = annual charges on capital investment t_w = pipe wall thickness, inches

For steam temperatures less than $775^{\circ}F$, the pipe material is assumed to be AlO6 Grade B and $c_1 = 5,200$ and $c_2 = \$10,000$. For temperatures greater than $775^{\circ}F$, the pipe material is assumed to be A335, P-11 and $c_1 = 5,700$ and $c_2 = \$80,000$.

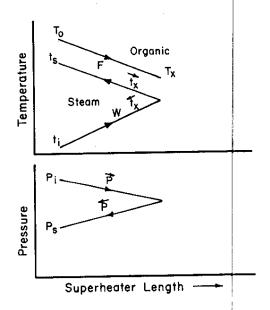
11.2.3 Superheater

The superheater unit is a horizontal U-tube design with the organic on the shell side. The temperature and pressure profiles are illustrated in the following sketch.

The lattice dimensions and characteristics of the superheater are:

Tube ID,
$$D_1 = 0.0413$$
 ft
Tube OD, $D_2 = 0.0521$ ft
Web, $D_C = 0.0281$ ft

The tube wall resistance for heat transfer, $1/h_W$, is 0.000231. The fouling resistance for the inside and outside of the tubes, $1/h_{fi}$ + $1/h_{fo}$ = 0.0010 + 0.0003.



A simplified flow diagram for the subroutine is given in Figure 11.4 which is a continuation of the steam pipe program given in the preceding section. An initial value for the number of tubes, $n_{\rm sh}$, is chosen, and then the heat transfer, the temperatures, and pressures are computed over a short length along the superheater shell, ΔL . The quantities $\Delta_{\rm p}$ and $\Delta_{\rm t}$ are computed at the end of each interval ΔL .

$$\Delta_{p} = \overrightarrow{P}_{x} - \overleftarrow{P}_{x}$$

$$\Delta_{t} = \overrightarrow{t}_{x} - \overleftarrow{t}_{x}$$

These values must become zero simultaneously after a sufficient number of ΔL intervals. This simultaneous conversion is achieved by appropriate choice of the number of tubes, $n_{\rm Sh}$. The temperature of the steam along the length of the tubes, $t_{\rm X}$, is obtained from the steam tables as a function of the pressure and the enthalpy where the pressure and the enthalpy at the end of the intervals are computed from the following set of equations:

$$\Delta \vec{q} = \frac{\vec{U}(T - \vec{t})(\pi D_{p} n_{sh} N_{p}) \Delta L}{W}$$

$$\Delta \vec{q} = \frac{\vec{U}(T - \vec{t})(\pi D_{p} n_{sh} N_{p}) \Delta L}{W}$$

where

U = the over-all heat transfer coefficient and is computed from the film temperatures

T = organic temperature

 $N_{\rm p}$ = number of primary coolant loops in the reactor complex

The change in enthalpy for the integral AL is given by

$$\overrightarrow{\Delta H} = \overrightarrow{\Delta q} - \frac{\overrightarrow{G_1^z} \overrightarrow{v_{av}} \Delta v}{Jg}$$

$$\Delta H = \Delta q - \frac{G_1^2 \stackrel{\longleftarrow}{v_{av}} \Delta v}{J_{\alpha}}$$

where

 v_{av} , Δv = average and change in specific steam volume along the interval ΔL

Gi = mass velocity of steam in the tubes of the superheater

Δq = incremental heat transfer per lb of steam flowing

J = 1400 ft-lb/pcu

The enthalpy at the end of the interval, H_{X} , then equals

$$\vec{H}_{\mathbf{v}} = \vec{H} + \Delta \vec{H}$$

$$\overline{H}_{\star} = \overline{H} + \Delta \overline{H}$$

and the steam temperature at the end of the interval is

$$\vec{t}_x = f(\vec{P}_x, \vec{H}_x)$$

$$\overleftarrow{\mathbf{t}}_{\mathbf{x}} = \mathbf{f} (\overleftarrow{\mathbf{P}}_{\mathbf{x}}, \overleftarrow{\mathbf{H}}_{\mathbf{x}})$$

The values of $P_{\mathbf{x}}$ for these expressions are obtained from the following equations:

$$\overrightarrow{\Delta P} = \frac{\overrightarrow{g_1}}{144 \ g} \left(\frac{2\overrightarrow{f}(\Delta L)\overrightarrow{v}_{av}}{D_1} + \overrightarrow{\Delta v} \right)$$

$$\Delta \overline{P} = \frac{G_1^2}{1^{1/4} g} \left(\frac{2f(\Delta L)v_{av}}{D_1} + \Delta v \right)$$

where the friction factor,

$$\frac{4}{f} = (0.046)/(\frac{4}{N_{Re}})^{0.2}$$

where N_{Re} = the Reynolds number for the steam flowing inside the tube

The number of tubes, $n_{\rm sh}$, is then varied in order to meet the criteria that $\Delta_{\rm p}$ and $\Delta_{\rm t}$ are simultaneously equal to zero. The design description of the superheater is then edited. This includes calculations of the pressure drop, the organic inventory, the heat exchange area, the tube and shell length, the pumping power, and the annual cost.

The annual cost, Ish, is computed from the following expression:

$$I_{sh} = C_{sh}A_{sh} + C_{o}B_{sh}$$

where

C_{sh} = annual cost of the superheater surface area, \$/yr/ft²

A_{sh} = required heat exchange area in the superheater, ft²

Co = cost of pumping the organic through the superheater, \$/bhp/yr

B_{sh} = brake horsepower or the shell side of the superheater, bhp

The annual cost of the superheater surface area, C_{sh} includes (1) fixed charges on equipment, (2) fixed charges on the coolant inventory (nondepreciable), (3) annual loss of coolant by pyrolytic decomposition, and (4) the fixed charges on incremental containment costs.

$$C_{sh} = a_{2}(CSH + 6.0) + \alpha_{1} c_{0}(a_{s}^{i} + Y_{cool})$$

where

CSH = cost of the heat exchange area, \$/ft, as computed from the equation in Section 8.2.7

6.0 = an estimate of the incremental containment costs

 α_1 = organic inventory in the superheater, lb/ft^2 of heat transfer area = 1.2

 $c_0 = cost of organic = $0.17/1b$

a₃ = charge rate on nondepreciable investment

a, = charge rate on depreciable investment

 Y_{cool} = fraction of coolant lost per year by pyrolytic decomposition

The cost of pumping organic coolant C_0 includes (1) incremental cost of pumps, motors, and backup equipment, (2) the cost of plant facilities to produce incremental power, and (3) the fuel cycle cost for the incremental power. Values that were assumed for each of these three components are:

- (1) Pump cost = \$56/bhp; motors and backup = \$50/bhp
- (2) Incremental power cost of \$100/kw = 78.2 bhp
- (3) Fuel cost of 1.5 mills/kwh = \$8.25/bhp/yr

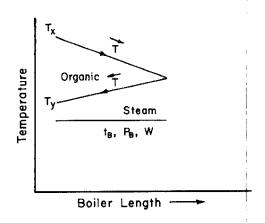
Therefore, $C_0 = 184.2a_2 + $8.25/bhp/yr$.

11.2.4 Boiler

The boiler units are vertical U-tube heat exchangers with carbon steel tubes and shells. The organic coolant passes through the tubes and the steam is produced on the shell side. The lattice dimensions for the boiler are:

Tube ID
$$D_1 = 0.0383$$
 ft
Tube OD $D_2 = 0.0521$ ft
Web $D_c = 0.0208$ ft

The tube wall resistance to heat transfer, $1/h_w$, is 0.000308. The fouling resistance for the internal and external surfaces are equal to 0.0010 and 0.0003, as in the superheater. The temperature profile along the length of the boiler is shown in the sketch below.



A simplified schematic for the boiler subroutine is shown in Figure 11.5. In a manner analogous to the superheater routine, an initial value of the number of tubes $n_{\rm B}$ is chosen and the temperature change of the organic along the length of the tubes is computed over small intervals ΔL . The values of \overline{T} and \overline{T} are computed after each interval until the difference is zero. Then the annual cost associated with the boiler is computed and the value of $n_{\rm B}$ is then systematically varied to minimize the annual cost of the boiler.

The change in the organic temperature ΔT along the interval, ΔL , is computed from the following expression:

$$\Delta \vec{T} = \frac{\vec{U}(\vec{T} - t_b)(D_2 n_B 2N_p) \Delta L}{\vec{Fc}}$$

$$\Delta \vec{T} = \frac{\vec{U}(\vec{T} - t_b)(D_2 n_B 2N_p) \Delta L}{\vec{Fc}}$$

where

U = over-all heat transfer coefficient and is computed from the film temperatures at each interval

n_B = number of heat exchanger tubes in the boiler unit

 N_{p} = number of primary coolant loops in the reactor complex

F = total flow of organic coolant, lb/hr

c = specific heat of the organic coolant in the interval ΔL , $Btu/(lb)(^{O}F)$

The organic temperature at the end of the interval is then

$$\vec{T}_{y} = \vec{T} - \Delta \vec{T} = T_{y} - \sum_{i} (\Delta \vec{T})$$

$$\vec{T}_{y} = \vec{T} - \Delta \vec{T} = T_{y} + \sum_{i} (\Delta \vec{T})$$

$$\vec{T}_{y} - \vec{T}_{y} = \Delta$$

The calculation proceeds to the next interval of shell length, ΔL , until the difference, Δ , becomes zero.

The annual cost for the boiler as given by

$$I_{B} = C_{B}A_{B} + C_{O}B_{B}$$

where

 C_B = annual cost of the boiler heat transfer area, f^2/y^2

AB = required heat transfer area for the boiler, ft2

 $C_{\rm o}$ = annual cost of pumping the organic through the boiler and is the same as the value of $C_{\rm o}$ in the superheater subroutine, ϕ

B_B = required brake horsepower for pumping the organic, bhp

The annual cost of steam generator surface area, $C_{\rm B}$, includes (a) fixed charges on equipment, (b) fixed charges on coolant inventory, (c) annual loss of coolant by pyrolytic decomposition, and (d) fixed charges on incremental containment costs. The expression for $C_{\rm B}$ is

$$C_B = a_2(CB + 2.7) + 0.54c_0(a_s + Y_{dool})$$

where the organic inventory is assumed to equal 0.54 lb/ft^2 of heat transfer area, and CB is the cost of heat transfer area in the boiler and is given by the equation in Section 8.2.7.

The incremental containment costs are estimated to be $\$2.7/ft^2$; a_2 and a_3 are the annual charge rates on depreciable and nondepreciable capital; c_0 is the cost of the organic, \$/lb; and Y_{cool} is the fraction of coolant lost per year by pyrolytic decomposition.

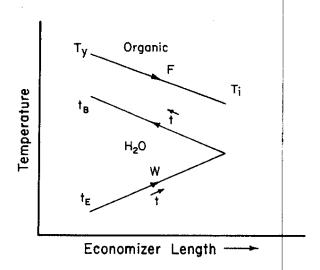
Within the subroutine the value of $n_{\rm B}$, the number of tubes, is varied until the annual charge, $I_{\rm B}$, reaches a minimum.

11.2.5 Economizer

The economizer is a carbon steel U-tube heat exchanger with the organic coolant on the shell side. The lattice dimensions for the economizer are:

Tube ID
$$D_1 = 0.0413$$
 ft
Tube OD $D_2 = 0.0521$ ft
Web $D_c = 0.0208$ ft

The tube wall resistance to heat transfer, $1/h_{\rm W}$, is 0.000231. The fouling resistances for the internal and external surfaces are assumed to be equal to 0.0010 and 0.0010, respectively. The temperature profile along the length of the economizer is illustrated in the following sketch.



A simplified schematic for the economizer subroutine is shown in Figure 11.6. The method of calculation is analogous to the boiler subroutine in that the number of heat exchanger tubes are varied to minimize the annual cost associated with the economizer unit. An initial value for the number of tubes, $n_{\rm e}$, is chosen and then the liquid $\rm H_2O$ temperatures are calculated at the end of intervals, ΔL , along the shell length. The liquid $\rm H_2O$ temperature, $\rm t_z$, is computed from the following equations:

$$\overrightarrow{t}_{z} = \overrightarrow{t} + \frac{\overrightarrow{U}(T - \overrightarrow{t})(\pi D_{z} n_{e} N_{p}) \Delta L}{\overrightarrow{Wc}}$$

$$\overrightarrow{t}_{z} = \overrightarrow{t} - \frac{\overrightarrow{U}(T - \overrightarrow{t})(\pi D_{z} n_{e} N_{p}) \Delta L}{\overrightarrow{Wc}}$$

$$\Delta = \overrightarrow{t}_{z} - \overrightarrow{t}_{z}$$

where

U= over-all heat transfer coefficient evaluated in the interval ΔL (The values of the film temperature are iterated on to be consistent with the computed value of U_{\bullet})

 N_{D} = number of primary coolant loops in the reactor

W = mass flow rate of H₂O through the economizer

c = heat capacity of the liquid ${\rm H_2O}$ at the start of the interval, ΔL

The difference between $\overrightarrow{t_z}$ and $\overleftarrow{t_z}$ are computed after each interval and the calculation is continued for successive intervals, ΔL , until this difference, Δ , reaches zero.

The annual cost of the economizer, $I_{\rm e}$, is then computed and the number of tubes, $n_{\rm e}$, is systematically varied to minimize the annual cost.

$$I_e = C_e A_e + C_w B_w + C_o B_o$$

where

 C_e = annual cost of the economizer heat transfer area, $f(t^2/yr)$

A_e = required heat transfer area for the economizer, ft²

C_W = annual cost of pumping the liquid water through the economizer, \$/bhp/yr

 B_{w} = required brake horsepower for pumping the water

 ${\rm C_O}={\rm annual\ cost\ of\ pumping\ the\ organic\ through\ the\ boiler}$ and is the same as the value of ${\rm C_O}$ in the superheater and boiler subroutines

Bo = required brake horsepower for pumping the organic

The annual cost of economizer surface area, C_e , includes (a) fixed charges on equipment, (b) fixed charges on coolant inventory, (c) annual loss of coolant by pyrolytic decomposition, and (d) fixed charges on incremental containment costs. The expression for C_e is given below and is identical to the expression for the analogous cost in the superheater subroutine

$$C_e = a_2(CEC + 6.0) + 1.2a_1(a_3 + y_{cool})$$

where CEC is the cost of heat transfer area in the economizer and is given by the equation in Section 8.2.7.

11.2.6 Optimization of Boiler Pressure

A schematic flow diagram of the steps involved in the optimization of the over-all steam generator complex is shown in Figure 11.7. The total annual cost, $I_{\rm sg}$, is computed from the annual costs of the steam pipe, superheater, boiler, and economizer sections.

$$I_{sg} = I_{sp} + I_{sh} + I_{B} + I_{e}$$

Then the boiler pressure, P_B , is systematically changed until the value I_{sg} reaches a minimum. At this point the program returns to the turbine optimization for the next choice of throttle conditions, P_t and T_t .

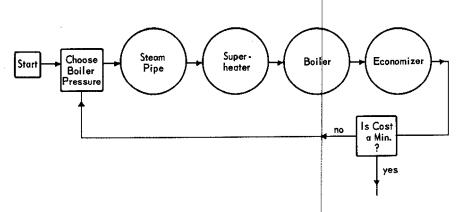


FIG. 11.1 FLOW DIAGRAM OF STEAM GENERATOR SUBROUTINE FOR ORGANIC-COOLED REACTOR DESIGN

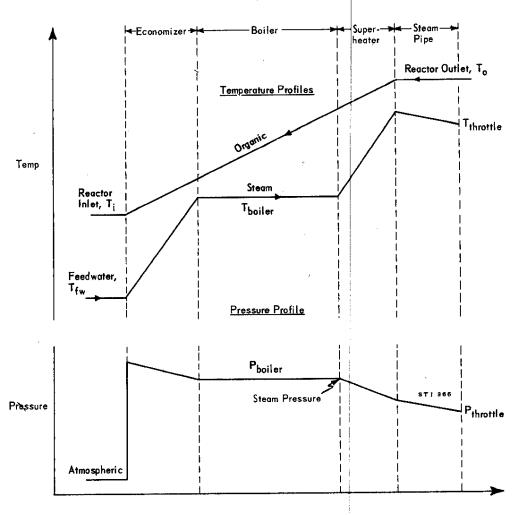


FIG. 11.2 TEMPERATURE AND PRESSURE PROFILES IN STEAM GENERATORS FOR ORGANIC - COOLED D20 - MODERATED POWER REACTORS

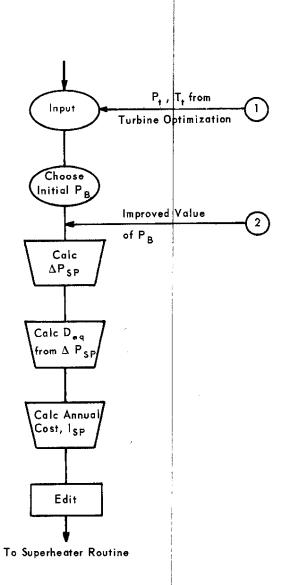


FIG. 11.3 STEAM GENERATOR OPTIMIZATION - STEAM PIPING SUBROUTINE

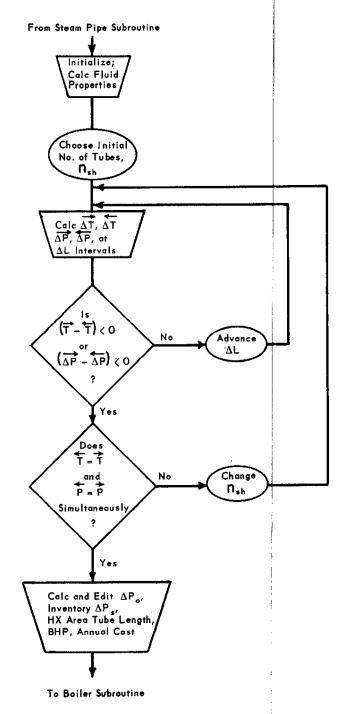


FIG. 11.4 STEAM GENERATOR OPTIMIZATION - SUPERHEATER SUBROUTINE

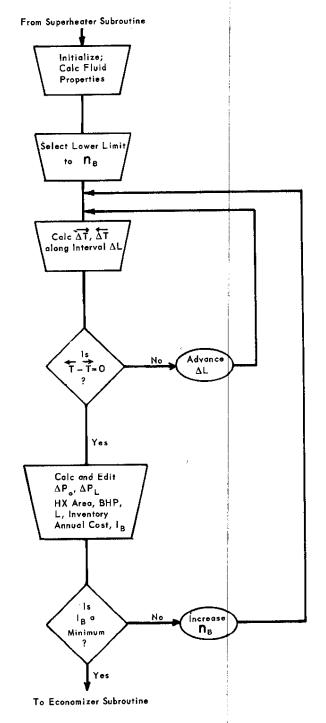


FIG. 11.5 STEAM GENERATOR OPTIMIZATION - BOILER SUBROUTINE

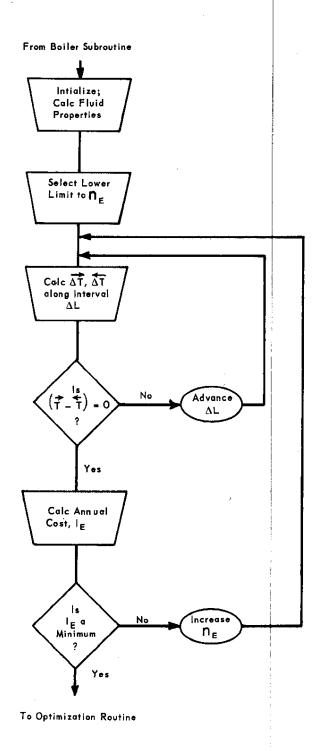


FIG. 11.6 STEAM GENERATOR OPTIMIZATION - ECONOMIZER SUBROUTINE

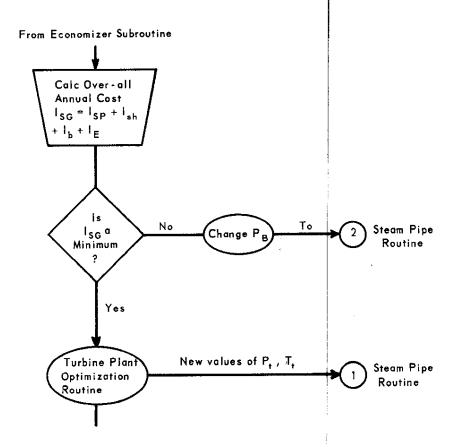


FIG. 11.7 STEAM GENERATOR OPTIMIZATION - OPTIMIZATION SUBROUTINE

12. Turbine Plant

12.1 Turbine Plant Design

All of the information associated with the turbine plant design and cost was developed by Sargent and Lundy, Engineers; a summary of their work on turbine plants for the organic-cooled reactor concept is given in SL-2008⁽⁴⁾. In the development of the information necessary for turbine plant optimization, a wide range of turbine plant steam and feedwater conditions were considered. Eight steam pressures (165, 400, 600, 800, 1000, 1200, 1400, and 1500 psia) were used and for each of these, five temperature conditions were selected in order to span the range from the saturation temperature to approximately 1000°F. The number of feedwater heating stages varied from 1 to 7 to provide a range of final feedwater temperatures from 150-515°F. These parameters were considered for 300-, 500-, and 1000-MWe plant capacities.

Gross turbine cycle efficiency curves were developed as a function of the final feedwater temperature on the basis of a 1.5-inch ${\rm H_gA}$ condenser pressure. A practical minimum pressure of 400 psia was selected for superheating; therefore saturated steam only was considered for the 165 psia unit.

Cycle efficiency curves were developed by calculating the turbine heat rate for a fixed final feedwater temperature as set with an optimum number of feedwater heaters at each throttle pressure. The feedwater heaters were placed in the cycle so that an approximately equal feedwater temperature rise occurs across each heater. New heat rates were determined for lower final feedwater temperatures by successively removing heaters until a nonextraction heat rate was determined for the throttle pressure considered. The optimum number of feedwater heaters and the outlet temperature from the final feedwater stage are listed in Table 12.1⁽⁴⁾.

Major mechanical equipment associated with each turbine cycle was sized in accordance with the capacities, pressures, and temperatures developed in calculating the turbine cycle efficiency. In sizing the equipment, certain assumptions were made that would reflect cost changes representative of those found in conventional plants. For example, the selection of turbine exhaust flow limits which dictate the particular machine to be used can vary over a limited range. The break point in changing condenser tube lengths also varies slightly among designers and manufacturers. Where such limits existed, a particular value was chosen on the basis of conventional plant experience and by limited consultation with major equipment manufacturers.

The cost of the turbine generator, condenser, condensate pumps, feedwater pumps, feedwater heaters, the piping system, circulating water pumps, purification systems, traveling screens, and auxiliary electrical equipment are all functions of the throttle pressure and feedwater temperature. The remaining equipment in a turbine plant does not vary appreciably with the throttle steam conditions.

The turbine plant structures include the turbine building and circulating water system structures. The turbine building houses the turbine plant equipment and the control room, machine shop, store room, office space, and personnel accommodations for the plant. These facilities are independent of the throttle steam pressure. The dimensions of the turbine hall are governed primarily by the turbine dimensions and the auxiliary equipment. The structures for the circulating water system vary appreciably with the turbine throttle pressure.

12.2 300-MWe Plants

The gross turbine efficiency and total turbine plant costs are given in Table 12.2⁽⁴⁾ for 201 turbine plant designs over a wide range of temperatures, pressures, and number of feedwater heaters.

Table 12.3 presents the cost summary for 201 discrete 300-MWe steam turbine plants. Data are given for each major component of the variable cost in Items 1 through 11. The other components of the turbine plant cost which do not vary are included as a constant factor. Also included is the cost of the feedwater piping within the reactor building.

12.3 500-MWe Plants

Gross turbine cycle efficiency and total costs are given in Table 12.4⁽⁴⁾ for 500-MWe plants at exhaust pressures of 1.5 in. ${\rm H_gA}$. The cycle efficiency data were prepared with data for a nominal 525,000 kw, 1800 rpm, cross compound turbine unit. These data cover the range in steam pressure from 400 to 1500 psia and steam temperatures from the saturation temperature to $1000^{\circ}F$.

Table 12.5⁽⁴⁾ presents the cost summary for 205 discrete 500-MWe turbine plants in the same format as given for the 300-MWe plants in the section above.

12.4 1000-MWe Plants

As with the 300- and 500-MWe plants, gross turbine cycle efficiency and total costs are given in Table 12.6 at exhaust pressures of 1.5 in. H_gA . These data were prepared for the following pressures: 1500, 1400, 1000, 800, and 600 psi. At each pressure the effects of superheating to $1000^{\circ}F$ were determined.

For the present program, it was necessary to establish a lower pressure limit for a single 1000-MWe machine. There was some variation among turbine generator manufacturers as to the limitation of units having a capacity of 1000 MWe. For the present program, 600 psia saturated steam turbine represented the lower pressure limit. This meant that below 600 psia would require the use of two 500-MWe turbine generator units operating in parallel.

A detailed cost summary for the 1000-MWe turbine plants is given in Table 12.7 where the data for the 400 psia plant correspond to the use of two 500-MWe turbine generators.

12.5 Turbine Efficiency Calculations

The gross turbine cycle efficiency data for the turbine plants given in Tables 12.2, 12.4, and 12.6 have been fit to a series of polynomials which are then used in the code to calculate the turbine efficiency. A polynomial fit as a function of the throttle pressure and final feedwater temperature, T_f , has been developed for the following degrees of superheat: 0, 100, 200, 300, 400, and $500^{\circ}F$. The polynomial fits are given by the following equation:

$$\eta_{\Delta T} = \sum a_{i,j} T_f^i P_t^j$$

where

 $\eta_{\Delta T}$ = gross turbine cycle efficiency with the degree of superheat equal to ΔT

 T_f = final feedwater temperature, ${}^{\circ}F$

 P_t = turbine throttle pressure, psia

a_{i,j} = coefficients used in the polynomial fit and are listed in Table 12.8 for the 300-, 500-, and 1000-MWe plants, respectively

12.6 Turbine Plant Cost Calculations

The turbine plant cost data⁽⁴⁾ given in Tables 12.3, 12.5, and 12.7 have been grouped into three major categories: (1) the cost of the turbine plant not including the turbine generator unit, (2) the turbine generator cost for saturated steam cycle, and (3) a correction for the turbine generator unit due to the effect of superheat. The data have been broken down in this fashion in order to effectively smooth the data and eliminate the discontinuities that result when one plots the cost vs pressure or degree of superheat. The cost of the turbine plant, $C_{\rm t}$, is then given by

$$C_t = C_1 + C_s + \Delta C_s$$

where

- ${\tt C_1}={\tt cost}$ of the turbine plant, exclusive of the turbine generator unit and is a function of final feedwater temperature, ${\tt T_f}$, the degree of superheat, ${\tt t_s}$, and the throttle pressure, ${\tt P_t}$
- C_s = cost of a turbine generator unit for saturated steam cycle and is a function of the turbine exhaust flow, F_1 , and the throttle pressure, P_t
- ΔC_s = difference between the unit for saturated steam and for superheated steam and is a function of degree of superheat, t_s , and the pressure, P_t

A correlation has been obtained for the ratio, R, of the turbine exhaust flow to the throttle flow, as a function of the pressure, final feedwater temperature, and degree of superheat. Then the turbine exhaust flow, F_1 , is given by $F_1 = R \cdot W$, where W is the turbine throttle flow obtained from the steam generator subroutine. It was found necessary to fit this correlation in two parts: (1) in the pressure range 1000 to 1500 psi and (2) in a range from 400 to 1000 psi. Table 12.9 lists the equations for the exhaust flow and the various components of the turbine plant cost. The subsequent tables, 12.10 through 12.12 give the coefficients of the polynomial fits for the various functions in Table 12.9.

12.7 Turbine Plant Optimization

The turbine plant conditions are chosen so that the over-all energy cost including the contribution of the turbine plant itself are minimized. The code first computes the design and cost of the reactor core and primary coolant systems, excluding the steam generators, and the fuel cycle costs. Thus, the input parameters for the turbine plant optimization consist of the inlet and outlet coolant temperatures, the fuel cycle costs, and the reactor costs.

The turbine plant efficiency and costs have been expressed in terms of the throttle pressure, P_t , the throttle temperature, T_t , and the temperature of the final feedwater returning from the turbine plant, T_f . For each reactor design, T_t , P_t , and T_f are systematically varied to determine the minimum energy cost. For each set of turbine conditions an optimum steam generator is computed as described in Section 11. Studies have shown that the optimum value of the final feedwater temperature is always the maximum value for any given value of Pt and Tt. Therefore the minimum cost is determined with respect to Pt and Tt. To determine this minimum, six sets of values for Pt and T+ are chosen and the total energy cost is computed for each of these six sets. These six sets are chosen within the following criteria: (1) the throttle pressure is greater than 400 \$si, (2) the throttle steam temperature must be greater than 2°C lower than the reactor outlet temperature, and (3) the minimum temperature difference (the pinch point) between the organic and the steam-water mixture in the boiler must be greater than 8°C. These six points then define a surface which can be approximated by

$$C = a_0 + a_1P_t + a_2P_t^2 + a_3T_t + a_4T_t^2 + a_5T_tP_t$$

where C is the energy cost in mills/kwh and the a_1 's are the coefficients that are evaluated from the six values of the cost. The values of P_t and T_t that give the minimum cost are determined from this equation, and the final energy cost is then recomputed.

TABLE 12.1 (SL-2008, p 56)

Heater Outlet Temperatures
Saturated and Superheated Steam Cycle Analysis

Throttle							
Press., Psia	Htr. #1	Htr. #2	Htr. #3	Htr. #4	Htr. #5	Htr. #6	Htr. #7
165	160	255	305	ı	ı	ı	;
007	160	236	308	365	1	•	1
009	165	226	286	346	907	ı	ı
800	150	210	260	320	379	439	ı
1000	160	220	280	340	507	465	1
1200	160	220	. 290	360	425	967	1
1400	150	200	260	320	380	777	505
1500	160	210	270	330	390	450	515

TABLE 12.2 (SL-2008, p 3)

SUBMARY OF 300 MMe H20 TURBINE FLANT CHARACTERISTICS Efficiency in 7, Cost in millions of dollars

ressure Paia . 1500																
1500	Degrees F Superheat	Act. Steam Temp. *F	٦	Cost	4	Cost	N	Cost	~	Cost	*	Cost	~	Cost	*	200
1500	SAT.	296	7.9%	•	36.0		35.5	,	34.8	,	33.9		32.8	1	31.8	
1500	8	36	4.75	39.79	30.00	19.55	36.5	39,30	37.7	19,17	34.9	91-61	34.0	19.07	32.0	19.11
	8	96	38.5	18.45	38	18.17	37.6	18,66	36.8	18.55	35.9	77.81	35.0	18,39	33.8	18.41
	300	968	39.8	18.16	39.3	17.95	38.7	17.83	37.9	17.70	37.0	17,62	35.9	18.20	34.6	18.2
	007	8	8.04	18.20	4.01	17.99	39.8	17.88	80,	17.76	37.8	17.70	8	17.62	35.4	18.28
	SAT.	£8.	36.0	\$0°*	35.7	30.02	35.2	19,81	34.5	19.70	33.6	19.65	32.6	19,66	31.4	19.76
	8	687	36.9	19.79	% %	19.50	36.2	19.32	35.5	19.19	34.7	19.13	33.6	19.12	32.6	19,8
0011	200	787	۳. ب	18.39	37.8	18.30	37.3	18.65	8	18.5	35.7	18.47	÷,	18.42	33.4	18.46
	8	1887	39.3	18.17	8	17.95	38.4	17.79	37.6	17.70	7.98	18.29	35.4	18.28	34.2	18.32
	00*	286	40.4	18.21	10,1	18.03	39.4	17.91	38.6	17.79	37.6	17.75	36.4	18.36	35.1	18.40
	SAT.	267			35.2	20.15	34.9	19.92	34.4	19.73	33.6	19.64	32.6	: 19.63	31,4	19.71
	8	£99			36.4	19,58	8,0	19.37	35.4	8T-6T	34.7	19.71	33.6	19.04	32.4	25.22
1200	8	191			37.4	18.88	37.1	18.70	% 9.6	18.55	35.8	18.45	¥.	18.37	33.3	07.81
	g	28.			38.6	18.00	K K	17.86	37.7	17.72	8,0	18.27	35.7	18.20	34.2	18,23
	007	84			39.7	18.06	39.4	17.93	38.8	17.80	37.9	17.68	% %	17.62	35.1	18.28
	SAT.	242			34.3	8	 7.	19.93	Š	19.76	% %	19.70	ď.	19.65	9	19.76
	8	र्ज :				19.52	35.2	19.34	34.0	19.2	8	19.17	72.	19.10	31.7	7
1000	8	74.5			e :	18.81	2	18.65	35.7	18. 13.	ф. Т	97.9	33	18.41	2	9
	3	£			37.8	18.62	2	R 1	e e	× .	٥, ٩	18.29	, i	7. 81	٠ :	2 2
	203	ZZ.			200	17.8		17.70	27.59	60.1		17.27	7.5	18.15	1	
	SAT.	518		,	۲. ا	27.17	9 10 10 10 10 10 10 10 10 10 10 10 10 10	K. 1	7.7	7.7.7	9.1	57.0	S. 1	7.	N.	7
;	8	3 i			, ,	19.43	37.7	19.29	9 (21.61	32.8	S :	32.0	25	P.	8;
9	2	87.			22.0	19.20	5	19.02	7.	18,81	25.	8.81	×.	18.8	2.0	S :
	8	818			8.8	18.60	8.5	18.46	35.9	18.31	35	18.26	33.9	18.19	32.4	18.2
	ğ	1018			38.9	17.92	2.3	17.82	38.0	17.67	۰ \$	18.27	35.7	18.17	7	18.20
	SAT	987					31.9	27.18	31.5	3	6.00 00.	20.99	30.1	20.93	29.0	8
	8	8					8	18.67	32.6	18.75	35.0	18,68	31.2	20,45	0.0	2
8	ĝ	989					34.1	8.8	33.8	17.94	33.1	17.86	32.2	17.84	30.9	19.89
	8	28					36.3	17.82	8,0	17.74	35.4	17.66	34.4	17.61	32.7	17.57
,	200	986					37.4	17.90	37.7	17.79	36.5	17.75	35.4	17.65	33.6	17.60
	SAT.	544							29.3	21.88	29.0	21.77	28.3	21.67	27.2	21,66
	8	24.5							8,	8	30	20.70	23.	20.59	8	7.79
001	500	545							, 1,	18.31	31.6	8	30.5	8	23.	8
	8	25 25 20 20 20 20 20 20 20 20 20 20 20 20 20							7.	17.75	۲, د در	17.5	e e	17.57	K 8	17.57
	3	3							22.4	J00/T	22.0	17:17	2	70-77	75.50	30

TABLE 12.3 (SI-2008, pp 57-91)

SUMMARY OF COST DATA 1500 PSIA, 696 F THROTTLE STEAM (100 F SUPERHEAT) 300 MWE INDIRECT CYCLE TURBINE PLANT

_								
_	HEATER ARRANGEMENT	77	6	5		3	. 2	1
1.	Turbine Generator And Accessories a. Turbine generator unit	8,920,000	8,920,000	8,920,000	8,920,000	8,920,000	8,920,000	8,920,000
	b. Turbine generator erection	390,000	390,000	390,000	390,000	390,000	390,000	390,000
	c. Reserve exciter	\leftarrow			nstant 🗼			\rightarrow
	d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000	167,000
2.	Condensers							
	a. Shells and accessories) 786,500	786,500	800,000	813,500	854,000	894,500	962,000
	b. Dry vacuum pumps c. Tubes	442,500	442,500	450,000	457,500	480,000	502,500	540,000
	d. Steam jet air equipment	19,250	19,250	17,500	17,500	17,500	17,500	35,000
	e. Erection	134,000	134,000	136,000	138,000	142,000	148,000	158,000
	f. Deseration - hot well of cond. g. L-P htrs. in exhaust stack	None 20,000	20,000	20,000	20,000	10,000	10,000	43,300 10,000
,	Circulating Water System	20,000	20,000	20,000	20,000	10,000	10,000	20, 00
٠,	A - Structures							
	a. Crib house)						
	a'. Substructure b'. Superatructure c'. Steel)	477 000	442 000	490.004	E00 000	e17 000	E41 000
	c'. Steel d'. Miscellaneous) 475,000	477,000	482,000	489,000	500,000	\$17,000	541,000
	b. Dredging	ý .						
	 c. Intake flume or forebay)						
	d. Seal well	}			i			
	e. Discharge flume f. Outfall)			1			
	B - Crib House Equipment (erected	oʻ			1			
	a. Traveling screens)			أمديد		*/ 6 000	
	 b. Screen wash pumps c. Screen wash piping) 129,000	129,000	132,000	134,000	139,000	146,000	156,000
	d. Chlorination equipment	<u> </u>			i			
	e. Chlorine handling)						
	C - Circulating water piping	479,000	480,000	484,000	489,00 0	497,000	508,000	525,000
	D - Circulating water pumps a, Pumps	186,000	187,000	191,000	195,000	202,000	214,000	228,000
	b. Motors	143,000	144,000	145,500	148,000	151,500	157,000	165,000
	c. Erection	18,300	18,400	18,600	18,800	19,300	20,000	21,000
4.	Feed Water Heaters				ľ			
	A - L-P Closed Heaters	136,000	137,000	87,000	87,500	44,000	45,000	-
	B - H-P Closed Heaters C - Descrating Heater	338,500	200,000 114,500	194,000 111,500	94,000	85,000	106.000	89,500
	C - Deserating Rester D - Insulation	117,500	114,300	111,300	109,000	107,500	106,000	-
	a. Closed heaters	8,750	5,650	4,000	1,900	1,000	-	-
	b. Deacrating	8,700	8,400	8,200	8,000	7,900	7,800	-
	E - Structural Work	24 500	17 500	14 000	7 000	7 000	_	_
	 a. For closed heaters b. For deaerating heater 	24,500 25,500	17,500 24,300	14,000 23,500	7,000 23,000	7,000 22,500	22,200	_
5.	Boiler Feed Pumps	,		,		,	,	
	a. Pumps and base plate	183,000	180,500	176,500	176,000	173,500	173,000	172,000
	b. Fluid drive	185,100	185,100	121,500	121,265	121,500	121,500	96,000
	c. Motors	311,000	294,000	268,000 13,500	254,000 12,900	250,500 12,300	232,500 11,900	225,500 11,500
	d. Erection e. Foundations for pumps	15,700 4,650	13,600 4,450	4,000	4,050	3,900	3,800	3,700
6.	Condensate Pumps	.,	.,		.,	-,	.,	
٠.	a. Pumps	51,000	50,600	33,000	33,900	26,500	27,000	_
	b. Motors	29,400	29,000	17,400	17,800	11,700	12,200	-
	c. Erection	5,400	5,400	5,100	5,200	5,000	5,100	-
7.	Piping And Insulation) 266 200	204 000	179 200	150 200	122 200	90,000	AB 200
	a. Extraction steam b. Heater vents and drains) 244,200	206,000	178,300	150,200	133,200	89,000	49,200
	c. Boiler feed piping	188,500	160,000	118,100	109,000	109,000	64,700	133,000
	d. Condensate piping) 69,900	69,900	61,500	61,500	56,700	56,700	-
	a'. From condensate pumps through L-P heaters)						
	b'. For D.C. heater and	,						
	B.F. pump suction)			İ			
	e. Main steam	15,200	15,200	15,200	15,200	13,500	13,500	13,500
В.	Demineralizing Equipment And							
	Condensate Storage Tanks	188,000	181,000	172,000	167,000	160,000	158,000	153,000
٠.	Electrical	138,400	138,400	129,700	126,300	125,500	121,900	105,700
ο.	Turbine Room Building				i			
·	a. Building	-	-	-	-	-	-	
	b. Turbine generator sub-base	-	-	-	-	-	-	•
1.	Condenser Pit-Size Increment			-	400	1,400	2,500	4,200
	TOTAL ITEMS 1-11	14,598,450	14,355,150	14,109,600	13,982,415	13,968,400	13,875,800	13,918,10
	TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,50
	TOTAL TURBINE PLANT COST	19,789,950	19,546,650	19,301,100	19,173,915	19,159,900	19,067,300	19,109,60
2.	Piping In Containment Vessel	476,100	322,100	322,100	319,900	317,600	317,600	319,800
	GRAND TOTAL		19,868,750			19,477,500	19,384,900	19,429,40
		,						

SUMMARY OF COST DATA
1500 PSIA, 796 F THROTTLE STEAM
(200 F SUPERHEAT)
300 MM= INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	7	6	5	4	 	3	<u>2</u>	1
1. Turbine Generator and Accessories	· · · · - · · · · · · · · · ·						-	
a. Turbine generator unit	7,810,000					8,440,000		
b. Turbine generator erection	390,000	390,000	390,000		000	390,000	390,000	390,000
c. Reserve exciter d. Turbine foundation	167,000	167,000	167,000	- Cons	000	167,000	167,000	167,000
2. Condensers	,	227,000	201,000		1	201,000	207,000	107,000
a. Shells and accessories) 732,500	746,000	759,500	773	000	800,000	840,500	894,500
b. Dry vacuum pumps)	,	,.		1	,	,	,
c. Tubes	412,500		427,500		000	450,000		
d. Steam jet air equipment e. Erection	19,250		17,500		500	17,500		
f. Deaeration - hot well of cond.	126,000 None	128,000	130,000	132	000	136,000	140,000	148,000 40,100
g. L-P htrs. in exhaust stack	20,000	20,000	20,000	20	000	10,000	10,000	
3. Circulating Water System A - Structures a. Crib house a'. Substructure b'. Superstructure) })]	·	·	
c'. Steel d'. Miscellaneous b. Dredging c. Intake flume or forebay d. Seal well e. Discharge flume f. Outfall B - Crib House Equipment (srected)) 460,000)))	462,000	467,000	474	000	484,000	499,000	518,000
a. Traveling screens)				1			
b. Screen wash pumps c. Screen wash piping d. Chlorination equipment) 122,000	123,000	125,000	128	000	132,000	138,000	146,000
e. Chlorine handling C - <u>Circulating Water Piping</u> D - <u>Circulating Water Pumps</u>) 468,000	470,000	473,000	478,	000	485,000	495,000	509,000
a. Pumps	176,000	178,000	181,000	185,	000	192,000	202,000	214,000
b. Motors	138,000	139,000	140, 500	143.	000	146,000	151,000	157,500
c. Brection	17,600	17,700	17,900	18,	200	18,600	19,300	20,000
4. Feed Water Heaters								
A - L-P closed heaters	129,500	129,500 191,000	83,500		000 500	42,500	43,500	96 500
B - <u>H-P closed heaters</u> C - <u>Deserating heater</u>	320,000 112,500		186,000 106,000	104,		74,000 103,000	102,000	86,500
D - Insulation		•	-				•	
 a. Closed heaters b. Deserating 	7,700	5,500	3,700		800 700	1,000	7 500	-
E - Structural Work	8,200	8,000	7,800	٠,	/00	7,600	7,500	-
a. For closed heaters	24,500	17,500	14,000		000	7,000	-	-
 For deaerating heater 	23,300	22,100	22,200	21,	800	21,500	21,200	-
5. Boiler Feed Pumps								
a. Pumps and base plate	178,000	176,000	173,000	172,	500	171,000	170,500	170,000
b. Fluid drive	185,100	121,500	121,500	121,		96,000	96,000	96,000
c. Motors d. Erection	275,500 14,100	253,500 13,300	240,500 12,300	229,	900	219,000 11,300	212,000 11,100	206,500 10,700
e. Foundations for pumps	4,300	4,100	3,900		800	3,700	3,600	3,550
6. Condensate Pumps		•	•			•	•	=
a. Pumpa	46,400	46,200	30,400	31,	200	24,700	25,000	•
b. Motors	27,100	26,800	16,300		600	11,000	11,500	-
c. Erection	5,000	5,000	4,800	4,	900	4,700	4,900	-
7. Piping and Insulation a. Extraction steam b. Heater vents and drains) 244,200	202,900	178,300	150,	000	121,100	89,000	49,200
c. Boiler feed piping d. Condensate piping	188,500	160,000	118,100	109,	000	109,000	64,700	133,000
a'. From condensate pumps thru L-P heaters	69,900	69,900	61,500	61,	500	52,200	52,200	-
b'. For D-C heater and B.F. pump suction)							
e. Main steam B. Demineralizing Equipment and	38,800	38,800	38,800	38,		29,600	29,600	29,600
Condensate Storage Tanks	176,000	168,000	161,000	157,		152,000	150,000	146,00
D. Electrical	126,000	122,600	125,900	122,	/00	121,900	118,400	97,400
O. Turbine Room Building a. Building	-6,400	-6,400	-	-		-	-	-
b. Turbine generator sub-base	-1,000	-1,000	-	- !		-		-
l. Condenser Pit-Size Increment	-	-	_	_		•	1,100	2,500
TOTAL ITEMS 1 - 11	19 000 000	12 021 050	12 445 400	19 947 4	200	19 251 000	13 105 600	13 222 544
TOTAL CONSTANT COST	5,191,500	12,974,050	13,465,400 5,191,500	13,347, 5,191, 18,539,		5,191,500	5,191,500	13,222,550 5,191,500
TOTAL TURBINE PLANT COST 2. Piping in Containment Vessel	18,447,550 532,100	18,165,550 378 100	18,656,900 378 100			18,443,400	18,387,100	18,414,050
		378,100	378,100	375,		366,300	366,300	366,300
GRAND TOTAL	18,979,650	18,543,650	19,035,000	18,915,	300	18,809,700	18,753,400	18,780,350

SUMMARY OF COST DATA
1500 FSIA, 896 F THROTTLE STEAM
(300 F SUPERHEAT)
300 MWE INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	7	6	5	4	3	2	1
1. Turbine Generator and Accessories							
a. Turbine generator unit	7,810,000	7,810,000 390,000	7,810,000 390,000	7,810,000 390,000	7,810,000	8,440,000 390,000	8,440,000 390,000
 b, Turbine generator erection c. Reserve exciter 	390,000	390,000	330,000	- Constant	÷		\longrightarrow
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000	167,000
2. Condensers) 692,000	692,000	719,000	732,500	746,000	786,500	840,500
 a. Shells and accessories b. Dry vacuum pumps) 692,000 }	0,2,000	-				/ 70 500
c. Tubes	390,000	390,000	405,000	412,500	420,000 17,500	442,500 17,500	472,500 35,000
d. Steam jet air equipment	19,250 120,000	19,250 120,000	17,500 124,000	17,500 126,000	128,000	134,000	140,000
 e. Erection f. Deseration - hot well of cond. 	None	220,000			 		37,800
g. L-P htrs. in exhaust stack	20,000	20,000	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System A - Structures a. Crib house a.'. Substructure b'. Superstructure c'. Steel d'. Miscellaneous))) 444,000	446,000	452,000	457,000	464,000	475,000	495,000
b. Dredging c. Intake flume or forebay d. Seal well e. Discharge flume f. Outfall B-Crib House Equipment (erected) a. Traveling screens b. Screen wash pumps c. Screen wash piping)))))) 116,000	116,000	119,000	121,000	124,000	129,000	137,000
d. Chlorination equipment	}				İ		
e. Chlorine handling C - Circulating Water Piping	457,000	458,000	462,000	466,000	471,000	479,000	493,000
D - Circulating Water Pumps	165,000	167,000	171,000	174,000	179,000	186,000	199,000
a. Pumps b. Motors	133,000	133,500	135,500	137,500	139,500	143,500	149,500
c. Erection	17,000	17,000	17,300	17,500	17,800	18,300	19,100
4. Feed Water Heaters		104 500	81 000	82,000	41,000	42,000	
A - L-P Closed Heaters	124,500 306,000	124,500 189,000	81,000 179,500	87,500	73,000	-	84,500
B - H-P Closed Heaters C - Deserating Heater	107,000	104,000	102,000	100,500	99,000	98,500	-
D - Insulation a. Closed heaters	7,200	4,900	3,500	1,700	950	-	-
b. Deserating	7,900	7,700	7,500	7,400	7,400	7,300	-
E - Structural Work	24 500	17 500	14,000	7,000	7,000	_	-
 a. For closed heaters b. For deserating heater 	24,500 22,500	17,500 21,700	21,300	20,900	20,600	20,500	-
5. Boiler Feed Pumps							140.000
a. Pumps and base plate	175,000	173,500	171,000 96,000	, 170,500 96,000	169,500 96,000	169,000 96,000	168,000 96,000
b. Fluid drivec. Motors	121,500 249,000	121,500 230,000	219,500	210,000	201,500	196,000	192,000
d. Erection	12,900	12,200	11,400	11,100	10,600	10,400	10,100
e. Foundations for pumps	4,050	3,900	3,700	3,600	3,500	3,500	3,400
6. Condensate Pumps	40 500	42 400	28,200	28,900	21,000	23,100	-
a. Pumps b. Motors	42,500 24,800	42,400 24,800	15,200	15,500	10,400	10,800	-
c. Erection	4,700	4,700	4,600	4,600	4,500	4,600	•
7. Piping and Insulation) 237,200	202,900	178,300	148,900	119,700	87,700	49,200
 Extraction steam Heater vents and drains)	•			109,000	64,700	133,00
 c. Boiler feed piping d. Condensate piping 	152,800	140,000	118,100	109,000	109,000	04,100	,
a'. From condensate pumps thru L-P heaters b'. For D.C. heater and)) 69,900)	69,900	61,500	55,400	50,600	50,600	-
B.F. pump suction) 49,700	49,700	44,700	44,700	44,700	44,700	44,70
e. Main steam 8. Demineralizing Equipment and	42,100	,		•			
Condensate Storage Tanks	166,000	159,000	155,000	148,000	145,000	144,000	141,00
9. Electrical	122,200	118,600	117,400	113,900	113,100	118,400	97,40
10. Turbine Room Building							
a. Building	-6,400 -1,000	-6,400 -1,000	-6,400 -1,000	-6,400 -1,000	-6,400 -1,000	:	-
b. Turbine generator sub-base	-1,000	-1,000	-1,000	-1,000	-1,000	-	1,10
11. Condenser Pit-Size Increment	-	-			!	19 616 166	
TOTAL ITEMS 1 - 11	12,964,700	12,760,750	12,635,300		12,424,450	13,010,100	13,045,80 5,191,50
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	r.	5,191,500	
TOTAL TURBINE PLANT COST	18,156,200	17,952,250	17,826,800		17,615,950	18,201,600	18,237,30
12. Piping in Containment Vessel	442,600	397,200	395,300	393,100	393,100	393,100	393,10
GRAND TOTAL	18,598,800	18,349,450	18,221,100	18,092,800	18,009,050	18,594,700	18,630,40
THE TARREST OF THE PARTY OF THE	,,						

1500 PSIA, 996 F THROTTLE STEAM (400 F SUPERHEAT) 300 MWe INDIRECT CYCLE TURBINE PLANT

						2		
HEATER ARRANGEMENT	7	6	2	5				1
Turbine Generator and Accessories a. Turbine generator unit	8,050,000	8,050,000	8,050,000	8,05	. 000	8,050,000	8,050,000	8,680,000
b. Turbine generator erection	390,000	390,000	390,000		,000	390,000	390,000	390,000
c. Reserve exciter	\leftarrow		Cons					\longrightarrow
d. Turbine foundation	167,000	167,000	167,000	167	,000	167,000	167,000	167,000
2. Condensers								
a, Shells and accessories	651,500	651,500	665,000	678	,500	705,500	732,500	773,000
b. Dry vacuum pumps ')								405.000
c. Tubes	367,500	367,500	375,000		,500	397,500	412,500	435,000
d. Steam jet air equipment	19,250	19,250	17,500		,500	17,500 122,000	17,500 126,000	35,000 132,000
 e. Erection f. Deaeration - hot well of cond. 	114,000 None	114,000	116,000	110	,000	122,000	120,000	34,800
g. L-P htrs. in exhaust stack	20,000	20,000	20,000	20	,000	10,000	10,000	10,000
-	20,000	20,000	,	_]	,			
3. Circulating Water System								
A - <u>Structures</u> a. Crib house								
a'. Substructure								
b'. Superstructure								
c'. Steel								
d'. Miscellaneous	429,000	431,000	435,000	441	,000	446,000	457,000	474,000
b. Dredging								
c. Intake flume or forebay								
d. Seal well				-				
e, Discharge flume) f. Outfall)								
B - Crib House Equipment (erected)								
a. Traveling screens								
b. Screen wash pumps)							101 000	100 000
c. Screen wash piping	110,000	110,000	112,000	114	,000	117,000	121,000	128,000
d. Chlorination equipment								
e. Chlorine handling)	447,000	448,000	451,000	455	,000	459,000	466,000	478,000
C - Circulating Water Piping D - Circulating Water Pumps	447,000	440,000	451,000	,	,,,,,,,	457,000	,	4.4,
a. Pumps	156,000	158,000	160,000	16	,000	167,000	174,000	185,000
b. Motors	128,000	128,500	130,000		,000	133,500	137,500	143,000
c. Erection	16,400	16,400	16,600	1	, 800	17,100	17,500	18,200
4. Feed Water Heaters								
A - L-P Closed Heaters	121,000	121,000	79,000	7	,000	40,000	41,000	-
B - H-P Closed Heaters	295,000	181,000	175,000		,000	71,500		82,500
C - <u>Desersting Heater</u>	103,000	99,500	98,500	91	,000	96,000	95,500	-
D - <u>Insulation</u>	6 200	4 900	2 300		600	950	_	_
a. Closed heaters	6,800 7,600	4,800 7,400	3,300 7,300		,600	7,200	7,100	_
b. Deserating E - Structural Work	7,000	7,400	7,300	ľ	, 200	7,200	7,100	
a. For closed heaters	24,500	17,500	14,000	1	,000	7,000	_	~
b. For deaerating heater	21,500	20,900	20,500		,200	20,000	19,800	-
5. Boiler Feed Pumps								
a. Pumps and base plate	173,000	171,000	170,500	16	500	168,000	167,000	166,000
b. Fluid drive	96,000	96,000	96,000		,000	96,000	96,000	96,000
c. Motors	228,000	211,500	202,500		,000	188,000	183,000	179,000
d. Erection	12,000	11,300	10,600		,400	10,000	9,800	9,500
e. Foundations for pumps	3,850	3,700	3,550	f	3,500	3,400	3,350	3,300
6. Condensate Pumps						20 (00	01 (00	
a. Pumps	39,400 23,200	39,200 23,100	26,200 14,300		, 900 , 600	20,600 9,800	21,600 10,200	-
b. Motors c. Erection	4,500	4,500	4,300		, 400	4,300	4,400	
7. Piping and Insulation	4,500	4,500	4,500	,	,,	4,500	,	
a. Extraction steam)	237,200	198,100	178,300	146	,900	119,700	87,700	49,200
b. Heater vents and drains		,		- 5		,		
c. Boiler feed piping	152,800	140,000	118,100	104	, 100	104,100	64,700	133,000
d. Condensate piping)	•			F				
a'. From condensate pumps)				1				
through L-P heaters)	65,300	65,300	55,400	5	400	50,600	50,600	-
b'. For D.C. heater and				į				
B.F. pump suction) e. Main steam	60,300	55,900	55,900	5,6	,900	55,900	55,900	55,900
	00,500	33,300	33,300	7	,,,,,,,	33,700	33,300	33,700
8. Demineralizing Equipment and	157 000	152 000	146,000	144	,000	140,000	138,000	136,000
Condensate Storage Tanks	157,000	152,000						
9. <u>Electrical</u>	116,700	113,200	112,000	110	, 900	109,600	109,600	93,900
 Turbine Room Building 								
a. Building	-6., 400	-6,400	-6,400		, 400	-6,400	- 6,400	-
b. Turbine generator sub-base	-1,000	-1,000	-1,000	-i	,000	-1,000	-1,000	-
 Condenser Pit-Size Increment 	~	-	-	}		-	-	-
TOTAL ITEMS 1 - 11	13,006,700	12,800,650	12,684,950	12,57	400	12,510,350	12,432,350	13,087,300
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5, 191		5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	18, 198, 400	17,992,150	17,876,450	17,764		17,701,850	17,623,850	18,278,800
	506,700		451,800		,600	449,600	449,600	449,600
2. Piping in Containment Vessel	-	451,800						
GRAND TOTAL	18,705,100	18,443,950	18,328,250	18,214	, 500	18,151,450	18,073,450	18,728,400

SUMMARY OF COST DATA 1400 PSIA, 587 F THROTTLE STEAM (SATURATED STEAM) 300 MWe INDIRECT CYCLE TURBINE PLANT

				2 505 000	3 355 000	2 057 000	3,180,000
THROTTLE FLOW, #/HR.	4,530,000	4,123,000	3,781,000	3,505,000	3,255,000	3,057,000	1
HEATER ARRANGEMENT		6					
. Turbine Generator and Accessories	2 2/2 222	9,240,000	9,240,000	9,240,000	9,240,000	9,240,000	9,240,000
 a. Turbine generator unit b. Turbine generator erection 	9,240,000 390,000	390,000	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter				onstant -	167.000	1/1 000	167.000
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000	167,000
. Condensers) 840 500				205 200	1 002 500	1 000 000
a. Shells and accessories b. Dry vacuum pumps	840,500	840,500	854,000	881,000	935,000	1,002,500	1,080,000
c. Tubes	472,500	472,500	480,000	495,000	525,000	562,500	774;000 33,250
d. Steam jet air equipment	19,250 140,000	19,250 140,000	17,500 142,000	17,500 146,000	17,500 154,000	17,500 164,000	167,000
 e. Erection f. Deseration - hot well of cond. 	1.0,000	2.0,000	•	-	-	•	45,000
g. L-P htrs. in exhaust stacks	20,000	20,000	20,000	20,000	10,000	10,000	10,000
. Circulating Water System							
A Structures a. Crib house	Y						
a'. Substructure	5						
b'. Superstructure	}						
c'. Steel d'. Miscellaneous) 499,000	500,000	504,000	514,000	534,500	558,000	543,000
b. Dredging	}	,		.	•		
c. Intake flume)						
d. Seal well e. Discharge flume	}						
f. Outfall	5			1			
B - Crib House Equipment (Erected)				i			
a. Traveling screens b. Screen wash pumps	3				152 200	163 000	156 000
c. Screen wash piping	38,000	138,500	140,000	144,000	152,300	162,000	156,000
 d. Chlorination equipment)						
e. Chlorine handling C - Circulating Water Piping	492,000	492,500	496,000	503,000	517,000	535,000	524,000
D - Circulating Water Pumps							
a. Pumps	199,975	200,450	203,300 152,105	209,950 155,625	223,500 162,400	238,925 170,760	224,130 175,160
b. Motors c. Erection	150,345 19,130	150,520 19,160	19,340	19,920	20,600	21,590	20,960
	,		•				
A - L-P closed heaters	146,000	145,500	91,000	91,500	46,000	47,000	-
B - H-P closed heaters	460,000	217,000	203,500	96,500	75,000	100 000	90,000
C - Descrating heater	129,000	124,000	118,000	115,000	112,000	108,000	•
D - <u>Insulation</u> a. Closed heaters	8,550	6,350	4,350	2,050	1,100	-	-
b. Desersting	9,600	9,100	8,700	8,400	8,100	7,900	-
E - Structural Work	24,500	17,500	14.000	7,000	7,000	-	_
 a. For closed heaters b. For deserating heater 	28,500	27,000	25,500	24,500	23,500	23,000	-
. Boiler Feed Pumps							
a. Pumps and base plate	180,000	175,500	171,000	169,500	166,500	165,000	165,000
b. Fluid drive	185,100	121,500 274,630	121,500 253,465	121,500 233,400	96,000 213,330	96,000 198,780	96,00 186,43
c. Motors d. Erection	305,280 27,000	25,200	23,100	21,900	20,400	19,500	19,80
e. Foundations for pumps	5,250	4,950	4,500	4,350	4,050	3,900	3,90
. Condensate Pumps				!			
a. Pumps	57,750	57,450	36,300	36,900 18,400	28,200 13,270	28,800 13,810	-
b. Motors c. Erection	31,090 5,900	30,820 5,900	18,130 5,450	5,500	5,200	5,400	-
Piping and Insulation	-,			- 1			
a. Extraction steam	243,400	210 600	102 400	151,900	119,400	83,900	49,200
b. Heater vents and drains	,	210,600	183,600	i i			
c. Boiler feed piping d. Condensate piping	179,300	163,400	113,600	104,700	104,700	59,800	123,50
a'. From condensate pumps)			!			
through L-P heaters	82,400	82,400	75,500	75,\$00	68,800	68,000	-
b'. For D-C heater and B.F. pump suction	}	•,		- 1			
e. Main steam	20,000	20,000	20,000	20,000	15,000	15,000	15,00
. Demineralizing Equipment and	•						
Condensate Storage Tanks	198,500	187,000	177,500	169,500	162,500	157,000	160,50
. Electrical	138,400	131,450	126,600	123,900	120,700	119,000	99,00
. Turbine Room Building	-			Base -			
***************************************	1,050	1,050	1,400	2,100	3,500	5,250	10,500
Condenser Pit-Size Increment TOTAL ITEMS 1 - 11	15,248,970	14,828,380		14,506,695	14,462,750	14,464,515	14,568,030
	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURNING PLANT COST	20,440,470	20,019,880	19,813,140	19,698,195	19,654,250	19,656,015	19,759,530
TOTAL TURBINE PLANT COST	436,000	390,000	350,000	326,000	310,000	306,000	300,000
2. PIPING IN CONTAINMENT VESSEL	20,876,470	20,409,880	20, 163, 140	20,024,195	19,964,250	19,962,015	20,059,530
GRAND TOTAL	20,6/6,4/0	£U, 4UY, 00U	20, 103, 140	FO10*4'193	-7,704,200	,,,	-,,

SUMMARY OF COST DATA
1400 PSIA, 687 F THROTTLE STEAM
(100 F SUPERMEAT)
360 MW INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	7	6	5			3	2	1
1. Turbine Generator and Accessories	····							
a. Turbine generator unit	8,920,000	8,920,000	8,920,000		, 000	8,920,000	8,920,000	8,920,000
b. Turbine generator erection	390,000	390,000	390,000	390	,000	390,000	390,000	390,000
c. Reserve exciter d. Turbine foundation	167,000	167,000	167,000		stant	: 167,000	167,000	167,000
. Condensers								
a. Shells and accessories	> 800,000	800,000	813,500	827	,000	867,500	921,500	989,000
b, Dry vacuum pumps c, Tubes) 450,000	450,000	457,500	469	,000	487,500	517,500	555,000
d. Steam jet air equipment	19,250	19,250	17,500		500	17,500	17,500	33,250
e. Erection	136,000	136,000	138,000		,000	144,000	152,000	162,000
f. Deseration - hot well of cond.	None							44,500
g. L-P htrs. in exhaust stack	20,000	20,000	20,000	20	,000	10,000	10,000	10,000
. Circulating Water System A - Structures								
a. Crib house)							
a'. Substructure	;							
b'. Superstructure) 480,000	481,000	485,000	492	,000	506,000	527,000	553,000
c'. Steel)							
d'. Miscellaneous	?							
 b. Dredging c. Intake flume or forebay 	'							
d. Seal well	Ś							
e. Discharge flume)							
f. Outfall	}							
B - Crib House Equipment (erected)	1							
a. Traveling screens b. Screen wash pumps) 131,000	131,000	133,000	135	,000	141,000	150,000	161,000
c. Screen wash piping)	,	,		•	•	•	•
d. Chlorination equipment)			i				
e. Chlorine handling)						ooo	544 000
C - Circulating Water Piping	482,000	483,000	486,000	491	,000	500,000	515,000	546,000
D - Circulating Water Pumps a. Pumps	189,500	190,000	193,000	197	,000	208,000	220,000	232,000
b. Motors	145,100	145,200	147, 700		,800	153,500	160,600	169,400
c. Erection	18,500	18,500	18,700	18	, 900	19,500	20,400	21,500
Feed Water Heaters								
A - L-P Closed Heaters	136,000	136,500	86,500		,500	44,000	45,000	-
B - H-P Closed Heaters	329,000	202,500	189,500		,000	74,500	****	87,500
C - Desersting Rester	118,000	117,000	111,500	109	,000	107,000	106,000	-
D - Insulation	8,400	5,600	3,950		,900	1,050	_	_
a. Closed heatersb. Deaerating	8,700	8,400	8,200		,000	7,900	7,800	-
E - Structural Work	•,,	-,	-,	Ì	′	•	•	
a. For closed heaters	24,500	17,500	14,000		,000	7,000		-
 For deserating heater 	25,400	24,200	23,500	22	,900	22,500	22,200	•
. Boiler Feed Pumps							144 000	142 000
a. Pumps and base plate	173,000	171,000	167,500		,500	164,500 96,000	164,000 96,000	163,000 96,000
b. Fluid drive c. Motors	185,100 293,000	121,500 273,000	121,500 259,500	241	,500	235,000	228,000	225,000
d. Erection	23,700	22,500	21,000		,500	19,500	19,000	18,500
e. Poundations for pumps	4,600	4,400	4,200		,100	3,900	3,800	3,700
. Condensate Pumps								
a. Pumps	51,300	51,000	33,600		,200	26,100	27,300	-
b. Motors	27,700	27,500	16,700		,000	12,600 5,000	13,400 5,200	-
c. Brection	5,400	5,400	5,100	1	,200	3,000	3,200	
Piping and Insulation) 243,400	210,600	183,600	151	,900	119,400	83,900	49,200
a. Extraction steam b. Heater vents and drains) 243,400	210,000	103,000	2.5	, ,,,,,	117,400	05,500	
c. Boiler feed piping	179,000	160,000	118,100	109	,000	109,000	64,400	133,000
d. Condensate piping)	•						
a'. From condensate pumps	}					E4 700	66 700	
thru L-P heaters	69,900	69,900	61,500	01	,500	56,700	56,700	-
b'. For D.C. heater and B.F. pump suction	{							
e. Main steam	18,100	14,200	14,200	14	,200	14,200	11,400	11,400
Demineralizing Equipment and								
Condensate Storage Tanks	189,000	180,000	170,000	16\$,000	160,000	157,000	154,000
	138,400	130,900	126,300	126	,300	121,900	121,900	105,700
. Electrical	130,400	130,500	,20,500	1.0	,500	1,,50	,	
Turbine Room Building a. Building	_	_	_	:	_	_	_	_
b. Turbine generator sub-base	-	-		i	_	-	-	-
	_	_	400		700	1,800	3,200	4,900
. Condenser Pit-Size Increment	-	-						
TOTAL ITEMS 1 - 11	14,599,950	14,304,550	14, 127, 250	14,001	, 100	13,941,050	13,924,700	14,005,550
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191	,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	19,791,450	19,496,050	19,318,750	19,192	600	19,132,550	19,116,200	19,197,050
. Piping in Containment Vessel	421,100	295,100	295,100		,100	295,100	288,500	288,500
GRAND TOTAL	20, 212, 550	19,791,150	19,613,850	19,487	, 700	19,427,650	19,404,700	19,485,550

SUMMARY OF COST DATA
1400 PSIA, 787 F THEOTILE STEAM
(200 F SUPERHEAT)
300 MW INDIRECT CYCLE TURBINE PLANT

_								
_	HEATER ARRANGEMENT	7	6	5	4	3	. 2	1
1,	Turbine Generator and Accessories						9 440 000	
	a. Turbine generator unit b. Turbine generator erection	7,810,000 390,000	7,810,000 390,000	8,440,000 390,000	8,440,000 390,000	8,440,000 390,000	8,440,000 390,000	8,440,000 390,000
	c. Reserve exciter	€	3,0,000		stant	390,000	3,0,000	
	d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000	167,000
2.	Condensers							
	a. Shells and accessories	746,000	759,500	773,000	786,500	813,500	854,000	908,000
	b. Dry vacuum pumps c. Tubes	420,000	427,500	435,000	442,500	457,500	480,000	510,000
	d. Steam jet air equipment	19,250	19,250	17,500	17,500	17,500	17,500	33,250
	e. Erection	128,000	130,000	132,000	134,000	138,000	142,000	150,000
	f. Deseration - hot well of cond. g. L-P htrs. in exhaust stack	None 20,000	20,000	20,000	20,000	10,000	10,000	41,000 10,000
3	Circulating Water System	20,000	20,000	20,000	20,000	10,000	10,000	10,000
	A - Structures				·			
	a. Crib house)			!			
	a'. Substructure b'. Superstructure)			:			
	c'. Steel	3						
	d'. Miscellaneous) 463,000	466,000	470,000	478,000	486,000	503,000	524,000
	b. Dredging)			ļ			
	c. Intake flume or forebay d. Seal well	{						
	e. Discharge flume	5			i			
	f. Outfall)]			
	B - Crib House Equipment (erected) a. Traveling screens	1			į			
	b. Screen wash pumps	5						
	c. Screen wash piping) 123,000	125,000	127,000	130,000	133,000	140,000	149,000
	d. Chlorination equipment	}			8			
	e. Chlorine handling C - Circulating Water Piping	470,000	473,000	475,000	481,000	487,000	498,000	513,000
	D - Circulating Water Pumps	,	-,-,	.,,,	,	,	,	
	a. Pumps	178,000	181,500	184,000	188,000	193,000	204,000	218,000
	b. Motors c. Erection	139,200 17,700	140,400 17,900	141,800 18,100	144,300	147,900 18,700	154,500 19,700	158,400 20,300
4	Feed Water Heaters	17,700	17,500	10,100	10,400	20,700	19,700	20,500
4.	A - L-P Closed Heaters	130,000	132,000	83,500	84,800	42,700	44,000	
	B - H-P Closed Heaters	312,000	192,000	181,500	88,500	72,200	-	84,500
	C - Deserating Heater	112,000	108,500	106,000	104,500	102,500	102,000	-
	D - <u>Insulation</u> a. Closed heaters	7,700	5,200	3,700	1,800	1,000	_	_
	b. Deserating	8,200	8,000	7,800	7,600	7,600	7,500	-
	E - Structural Work							
	 a. For closed heaters b. For deserating heater 	24,500 23,700	17,500 22,800	14,000 22,200	7,000 21,800	7,000 21,400	21,200	-
٠,		23,,00	22,000	12,200	22,000	24,400	21,200	•
٠.	a. Pumps and base plate	168,500	167,000	164,000	163,500	162,000	161,500	161,000
	b. Fluid drive	121,500	121,500	96,000	· 96,000	96,000	96,000	96,000
	c. Motors	265,500	246,000	235,500	225,000	213,000	208,000	208,000 17,600
	d. Erection e. Foundations for pumps	21,700 4,300	20,700 4,100	19,500 3,900	19,000 3,800	18,200 3,700	18,000 3,600	3,500
6	Condensate Pumps	4,500	4,200	2,,,,,	3,000	3,,,	•,•••	-,
٠.	a. Pumps	47,100	46,800	31,200	31,500	24,300	25,500	-
	b. Motors	25,400	25,300	15,500	15,900	11,800	12,400	-
_	c. Erection	5,000	5,000	4,800	4,900	4,700	4,700	-
7.	Piping and Insulation a. Extraction steam) 242,300	210,600	179,900	149,200	119,400	83,900	49,200
	b. Heater vents and drains) 242,300	210,000	273,300	149,200	4.7,400	43,300	-5,200
	c. Boiler feed piping	179,000	160,000	118,100	109,000	109,000	64,400	133,000
	d. Condensate piping) /			i			
	 a'. From condensate pumps through L-P heaters)) 69,900	69,900	61,500	61,500	52,200	52,200	-
	b'. For D.C. heater and)	,.	,				
	B.F. pump suction)	** ***		20 224			20.000
	e. Main steam	42,900	38,800	38,800	38,800	38,800	38,800	38,800
8.	Demineralizing Equipment and Condensate Storage Tanks	175,000	168,000	160,000	157,000	152,000	150,000	147,000
٥	Electrical	173,500	122,600	122,300	122,300	118,400	118,400	97,400
	Turbine Room Building	12/,300	121,000		, 500	220,400	110,400	,,,400
IV.	a. Building	-6,400	-6,400	_	-	_	_	-
	b. Turbine generator sub-base	-1,000	-1,000	-	- !	-	-	-
11.	Condenser Pit-Size Increment	-	-	-	-	400	1,400	2,800
	TOTAL ITEMS 1 - 11	13,197,450	13,011,950	13,460,100	13,350,600	13,277,400	13,233,200	13,270,750
	TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5, 191, 500	5,191,500	5,191,500	5,191,500
	TOTAL TURBINE PLANT COST	18,388,950	18, 203, 450		18,542,100	18,468,900	18,424,700	16,462,250
12	Piping in Containment Vessel	473,600	378,100	378,100	378,100	378,100	375,900	375,900
- 4 -	GRAND TOTAL					18,847,000		
	ORANO IVIAL	10,002,330	.0, ,0,,,00	25, 425, 144	-0, -=0, =00	20,047,000	,,	,,

SUMMARY OF COST DATA
1400 PSIA, 887 F THROTTLE STEAM
(300 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

	HEATER ARRANGEMENT	7	6		4	3	2	1
ī.	Turbine Generator And Accessories				2 212 222	9 440 000	0.440.000	8,440,000
	a. Turbine generator unit	7,810,000	7,810,000	7,810,000	7,810,000	8,440,000 390,000	8,440,000 390,000	390,000
	b. Turbine generator erection	390,000	390,000	390,000 Co	390,000 natant ———	390,000	370,000	
	c. Reserve exciter d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000	167,000
2.	Condensers			705 500	772 5	759,500	813,500	867,500
) 705,500)	705,500	705,500	732,500	739,300	613,300	507,500
	b. Dry vacuum pumps c. Tubes	397,500	397,500	397,500	412,500	427,500	457,500	487,500
	d. Steam jet air equipment	19,250	19,250	17,500	17,500	17,500	17,500	33,250
	e, Erection	122,000	122,000	122,000	126,000	130,000	138,000	144,000
	f. Deseration - hot well of cond.	None			20.00	10.000	10,000	39,000 10,000
	g. L-P htrs, in exhaust stack	20,000	20,000	20,000	20,000	10,000	10,000	10,000
3.	Circulating Water System A - Structures							
)						
)				450 000		E00 000
	b'. Superstructure) 447,000	448,000	450,000	458,000	470,000	489,000	509,000
	c'. Steel)						
	d'. Miscellaneous	(i			
	 b. Dredging c. Intake flume or forebay 	Ś			1			
	d. Seal well	Ś			-			
	e. Discharge flume	<u> </u>			i			
	f. Outfall)			1			
	B - Crib House Equipment (exected)							
	a. Traveling screens) 117,000	117,000	118,000	122,000	127,000	134,000	142,000
	 b. Screen wash pumps c. Screen wash piping) 117,000	117,000	110,000	122,000	14.,000	,	
	d. Chlorination equipment	`						
	e. Chlorine handling)						
	C - Circulating Water Piping	459,000	460,000	462,000	467,000	475,000	489,000	502,000
	D - Circulating Water Pumps					100 000	105 000	100 000
	a. Pumps	167,500	168,000	170,000	175,000	183,000 141,600	195,000 147,900	208,000 154,500
	b. Motors	133,800 17,100	134,100 17,100	135,000 17,2 0 0	137,700 17,600	18,100	18,800	19,600
	c. Erection	17,100	17,100	.,,,,,,,,,,	,	,	,	
•	Feed Water Heaters	125,500	125,000	81,000	82,000	41,500	42,500	_
	A - L-P Closed Heaters B - H-P Closed Heaters	299,500	186,500	175,500	85,500	71,000	-	82,500
	C - Deaerating Heater	107,000	104,000	102,000	100,500	99,500	99,000	-
	D - Insulation							
	a. Closed heaters	7,200	4,900	3,500	1,650	950	7 700	-
	b. Deaerating	7,900	7,700	7,500	7,400	7,400	7,300	-
	E - Structural Work	24,500	17,500	14,000	7,000	7,000		_
	 a. For closed heaters b. For deserating heater 	22,500	21,700	21,200	20,900	20,600	20,500	-
		,	,					
٠.	Boiler Feed Pumps a. Pumps and base plate	166,000	164,500	162,000	161,500	160,500	160,000	159,000
	b. Fluid drive	121,500	96,000	96,000	96,000	96,000	96,000	96,000
	c. Motors	243,000	225,000	216,000	207,000	198,000	193,500	193,500
	d. Erection	20,200	19,300	18,300	18,000	17,200	17,100	16,800 3,400
	e. Foundations for pumps	4,000	3,900	3,700	3,600	3,500	3,400	3,400
5.	Condensate Pumps			00 100	20. 400	22 100	24,000	_
	a. Pumps	44,100	43,800 23,400	29,100 14,500	30,000 14,800	23,100 11,200	11,800	_
	b. Motors c. Erection	23,500 5,000	5,000	4,800	4,900	4,700	4,900	-
		5,000	3,000	7,200	.,.			
٠	Piping And Insulation a. Extraction steam) 238,700	204,200	178,700	147,900	117,700	83,900	49,200
	b. Heater vents and drains)	20-7,200	2.0,				
	c. Boiler feed piping	144,700	140,000	118,100	109,000	109,000	64,400	133,000
	d. Condensate piping)			i			
	a'. From condensate pumps)	(0.000	/1 FAO		50,600	50,600	_
	through L-P heaters) 69,900	69,900	61,500	55,400	30,000	30,000	
	b'. For D.C. heater and B.F. pump suction)						
	e. Main steam	52,900	48,700	44,700	44,700	44,700	44,700	44,700
		•			İ			
•	Demineralizing Equipment And Condensate Storage Tanks	165,000	159,000	152,000	150,000	145,000	144,000	141,000
		•		117,400	113,900	114,900	114,900	93,900
	Electrical	118,600	118,600	117,400	113,500	114,700	114,500	
	Turbine Room Building				مملاء	_	_	_
	a. Building	-6,400 -1,000	-6,400 -1,000	-6,400 -1,000	-6,400 -1,000	-	-	=
	b. Turbine generator sub-base	-1,000	-1,000		-1,000	_	400	1,800
	Condenser Pit-Size Increment	-		· · ·		- 		
	TOTAL ITEMS 1-11	12,976,450	12,756,650	12,595,800	12,507,050	13,100,250	13,090,140	13,128,150
	TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
						18,291,750	18,281,640	18,319,650
	TOTAL TURBINE PLANT COST	18,167,950	17,948,150	17,787,300	17,698,550		393,100	393,100
	Piping In Containment Vessel	442,600	397,200	395,300	393,100	393,100	333,100	272,100
	GRAND TOTAL	18,610,550	18,345,350	18, 182, 600	18,091.650	18,684,850	18,674,740	18,712,750
		,,	,,	.,,				

SUMMARY OF COST DATA
1400 PSIA, 987 F TRROTTLE STEAM
(400 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

				i			
HEATER ARRANGEMENT	7	6	5	4	3	2	1
Turbine Generator and Accessories a. Turbine generator unit	8,050,000	8,050,000	8,050,000	8,050,000	8,050,000	8,680,000	8,680,000 390,000
b. Turbine generator erection c. Reserve exciter	390,000	390,000	390,000	390,000 - Constant	390,000	390,000	167,000
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000	
2. Condensers a. Shells and accessories) 665,000	665,000	678,500	692,000	719,000	759,500	813,500
b. Dry vacuum pumps	375,000	375,000	382,500	390,000	405,000	427,500	457,500
c. Tubes d. Steam jet air equipment	19,250	19,250	17,500	17,500	17,500	17,500	33,250 138,000
e. Erection	116,000	116,000	118,000	120,000	124,000	130,000	36,500
f. Deacration - hot well of cond. g. L-F htrs. in exhaust stacks	None 20,000	20,000	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System A - Structures a. Crtb house a'. Substructure b'. Superstructure c'. Steel	}				/FF 000	470,000	489,000
d'. Miscellaneous b. Dredging c. Intake flume or forebay d. Seal well e. Discharge flume f. Outfall B - Crib House Equipment (erected)) 432,000)))	433,000	436,000	443,000	455,000	4,0,000	,
a. Traveling screens b. Screen wash pumps c. Screen wash piping d. Chlorination equipment)) 111,000)	111,000	113,000	115,000	120,000	127,000	134,000
e. Chlorine handling C - Circulating Water Piping.	449,000	449,000	452,000	456,000	465,000	475,000	489,000
D - Circulating Water Pumps	158,000	158,500	161,000	165,500	173,000	183,000	195,500
a. Pumps	129,000	129,200	130,500	132,900	136,400	141,500	147,900
b. Motors c. Erection	16,500	16,500	16,700	16,900	17,400	18,100	18,800
4. Feed Water Heaters A - L-P Closed Heaters	111,000	121,500	80,000	80,000	40,500	41,500	80,500
B - H-P Closed Heaters C - Deaerating Heater	289,500 103,000	179,000 100,000	171,500 98,500	84,50 0 97,00 0	70,500 96,000	95,500	-
D - Insulation a. Closed heaters b. Deserating	6,750 7,600	4,700 7,600	3,300 7,300	1,600 7,200	900 7,100	- 7,100	:
E - Structural Work a. For closed heaters	24,500	17,500	14,000	7,000	7,000	19,800	:
b. For deserating heaters	21,500	20,900	20,500	20,100	20,000	19,000	-
5. Boiler Feed Pumps	164,000	162,000	161,500	159,500	159,000	158,500	157,500
a. Pumps and base plate	96,000	96,000	96,000	96,000	96,000	96,000	96,000
b. Fluid drivec. Motors	225,000	208,000	201,000	192,000	184,500	180,000	180,000
d. Erection	19,100	18,300	17,400	17,100	16,500	16,300 3,300	16,000 3,300
e. Foundations for pumps	3,900	3,700	3,600	3,500	3,400		
6. Condensate Pumps	42,000	41,700	27,600	28, 200	22,200	22,800	-
a. Pumps b. Motors	21,600	21,500	13,700	14,000	10,600	11,100	-
c. Erection	4,800	4,700	4,500	4,600	4,500	4,700	
7. Piping and Insulation a. Extraction steam b. Heater vents and drains) 238,700	204,200	178,700	147,900	117,700	83,900	49,200
c. Boiler feed piping d. Condensate piping	144,700	140,000	118,100	104,100	104,100	64,400	133,000
a. Condensate piping a'. From condensate pumps thru L-P heaters b'. For D.C. heater and	65,300	65,300	55,400	55,400	50,600	50,600	-
B.F. pump suction e. Main steam) 59,800	59,800	59,800	59,800	59,800	59,800	59,800
8. Demineralizing Equipment and	157,000	151,000	145,000	144,000	140,000	139,000	137,000
Condensate Storage Tanks	118,200	114,700	113,900	110,400	109,600	114,900	93,900
9. Electrical 10. Turbine Room Building	-6,400	-6,400	-6,400	-6,400	-6,400	-	-
a. Buildingb. Turbine generator sub-base	-1,000	-1,000	-1,000	-1,000	-1,000		400
11. Condenser Pit-Size Increment	Base	-	-	-			
TOTAL ITEMS 1 - 11	13,014,300 5,191,500	12,834,150 5,191,500		12,603,300 5,191,500			
TOTAL CONSTANT COST	18,205,800	18,025,650					18,398,050
TOTAL TURBINE PLANT COST				,	449,600	449,600	449,600
12. Piping in Containment Vessel	506,700	451,800	451,800	449,600	18,203,500		
GRAND TOTAL	18,/12,500	10,4//,430	18,359,900	10,144,400	10,203,300	20,000,400	

SUMMARY OF COST DATA
1200 PSIA, 567 F THROTTLE STEAM (SATURATED STEAM)
300 MWe INDIRECT CYCLE TURBINE PLANT

Electrical Concretor and Accessories 9,240,000 167,000 1	_	THROTTLE FLOW, #/HR.		4,418,000	4,065,000	3,724,000	3,431,000	3,249,000	3,204,000
2. Turbine generator unit 9,240,000	_			6	5	4	3	2	1
2. Turbine generator unit 9,240,000	1	Turbine Generator and Accessories							
C. Reserve sactace (6.7,000 167,000 1	٠.	a. Turbine generator unit		9,240,000		9,240,000	9,240,000	9,240,000	9,240,000
Concentration 167,000				390,000	390,000	dons	tant =	350,000	
2. Shells and accessories				167,000	167,000	167,000	167,000	167,000	167,000
5. Dry vacuum pumps	2,								
C. Tubes 487,500 350,400 525,000 556,500 753,000 131,400 17,500 131,700 133,20				867,500	881,000	908,∳00	935,000	1,002,500	1,068,000
144,000 146,000 150,000 154,000 164,000 154,000 164,			•	487,500				562,500	765,400
### ### ### ### ### ### ### ### ### ##								17,500	33,250
C. Circulating Mater System 20,000 20,000 20,000 10,000				144,000	146,000	130,000	134,000	104,000	44,500
A. Structures A. Cith Montes A. Cith Montes A. Share well all the structure A. Share well all the structure A. Share well all the structure A. Share well all the structure B. Structure flume C. Share well all the structure B. Structure flume B. Structure flume C. Share well all the structure flume B. Structure flume B. Structure flume C. Structure flume C. Structure flume C. Structure flume C. Structure flume C. Structure flume C. Structure flume C. Structure flume C. Structure flume B. Motors C. Structure flume C. S				20,000	20,000	20,000	10,000	10,000	10,000
a. Grib house al. Substructure bl. Superstructure bl. Superstructure bl. Superstructure bl. Superstructure bl. Superstructure bl. Streen was place cl. Tracket flume cl. State		Circulating Water System							
a'. Substructure b'. Superstructure c'. Steel d'. Minerellaneous d'. Minerellaneous c. Inteke flung d. Sal well e. Discharge flune f. Outfall s. Discharge flune f. Outfall s. Sal well e. Discharge flune f. Outfall b. Screen wash piping d. Chierination equipmen c. Screen wash piping d. Chierination equipmen e. Chievine handling b. Screen wash piping d. Chierination equipmen e. Chievine handling b. Screen wash piping d. Chierination equipmen e. Chievine handling b. Screen wash piping d. Chierination equipmen e. Chievine handling b. Screen wash piping d. Chierination equipmen e. Chievine handling b. Screen wash piping d. Chierination equipmen e. Chievine handling b. Screen wash piping d. Chierination equipmen e. Chievine handling b. Screen wash piping d. Chievine handling b. Screen wash piping d. Chievine handling b. Screen wash piping d. Chievine handling b. Screen wash piping d. Chievine handling b. Screen wash piping d. Chievine handling b. Screen wash piping d. Chievine handling b. Screen wash piping d. Chievine handling b. Screen wash piping d. Chievine handling b. Screen wash piping d. Chievine handling b. Screen wash piping d. Chievine handling b. Screen wash piping d. Chievine handling b. Screen wash piping d. Chievine handling b. Screen wash piping d. Chievine handling d. Chievine handling d. Chievine handling d. Screen wash piping d. Chievine handling d. Chievine handling d. Screen wash piping d. Chievine handling d. Chievine h		A Structures	` `						
b'. Superstructure c'. Steel d'. Hiscellaneous S. Dredging c. Steel Steel S. Dredging c. Steel S. Dredging c. Steel command S. Dredging command comman									
c'. Sreel d'. Miscellaneous 5. Dredging 6. Drake fing 6. Drake fing 8. Chroke fing 9. Chroke fing 8. Traveling screens 9. Screen wash pings 6. Screen wash pings 6. Screen wash pings 6. Screen wash pings 6. Chroke fing 8. Chlorine handling 7. Circulating Mater Pings 9. Pings Pings 9. Pings Pings Pings Pings 9. Pings Pings Pings Pings 9. Pings Pings Pings Pings 9. Pings Pings Pings Ping									
D. Dredging		c'. Steel)						
c. Intake flume d. Seal well e. Discharge flume f. Outfall D. Green usah pumps c. Sereen wash piging d. Chicrination equipment b. Screen wash piging d. Chicrination equipment c. Circulating Mater Fungs D. Girculating Mater Fungs 10, 151,000 502,000 509,000 515,000 532,000 522,00 D. Girculating Mater Fungs 10, 154,480 154,480 154,520 158,000 161,355 169,440 174,55 C. Erection 10, 161,000 102,500 103,000 21,350 22,705 222,71 D. Girculating Mater Fungs 11,4,480 154,480 154,520 158,00 161,355 169,440 174,55 C. Erection 11,640 19,700 102,500 103,000 502,000 21,470 20,8 C. Erection 11,640 19,700 102,500 103,000 50,500 52,500 - 22,500 C. Desernating heaster 127,000 122,000 118,000 114,000 112,000 - 22,50 C. Desernating heaster 127,000 122,000 118,000 114,000 112,000 - 22,50 C. Desernating heaster 127,000 122,000 118,000 114,000 112,000 - 22,50 C. Desernating heaster 1,7,100 5,100 2,500 20,700 1,000 112,000 - 22,50 C. Desernating heaster 1,7,100 5,100 2,500 20,700 1,000 1			~	511,000	513,000	523,600	532,000	555,000	541,000
d. Seal well			Ś						
f. Outfail s. Travaling serems b. Scrie nussin jumps d. Chiorination equipment c. Chiorination equipment c. Chiorination equipment c. Chiorination equipment c. Chiorina handling C. Circulating Water Piping D. Circulating Water Piping C. Circulating Water Piping D. Circulating Water Piping C. Circulating Water Piping D. Circulating Water Piping D. Circulating Water Piping L. Chiorina Water Piping D. Circulating Water Piping D. Circulating Water Piping D. Circulating Water Piping L. Chiorina Water Piping D. Circulating Water Piping L. Chiorina Water Piping D. Circulating Water Piping L. Chiorina Water Piping D. Circulating Water Piping D. Circulating Water Piping L. Chiorina Water Piping L. Chiorina Water Piping D. Circulating Water Piping L. Chiorina Water Pipin			,			i			
B. Cittle House Equipment (Erected) a. Travelting screens b. Screen wash piping d. Screen wash piping d. Chiorination equipment d. Chiorination d. C		e. Discharge flume	Ş			į			
a. Traveling acreems			,			:			
b. Screen wash pipes c. Screen wash pipes d. Chlorination equipment d. Chlorination equipment d. Chlorination equipment d. Chlorination equipment d. Chlorination equipment d. Chlorination equipment d. Chlorination was a constraint with the pipes d. Chlorination was a constraint)			!			
d. Chlortnation equipment s. Chlorine hundling C. Circulating Mater Piping D. Circulating Water Piping D. Circulating Water Piping D. Circulating Water Piping D. Motors a. Pumps B. Motors C. Erection D. Motors C. Erection D. Motors C. Erection D. Motors C. Erection D. Motors C. Erection D. Motors D. Motor)			<u>İ</u>		161 000	355 000
## Chiorine handling 501,000 502,000 509,000 515,000 532,000 522,000 522,000 502)	143,000	144,000	147,950	151,000	161,000	155,000
C. circulating Mater Piping D. Circulating Mater Pumps a. Pumps b. Motors c. Erection 19,640 19,700 20,150 20,150 20,150 20,150 20,150 20,150 20,150 20,150 20,150 20,150 20,180 21,170 20,180			,			ŀ			
D. Circulating Mater Pumps 208,050 209,000 216,000 221,350 237,025 222,77			,	501,000	502,000	509,500	515,000	532,000	522,000
Notes				-					202 727
Feed Water Heaters							221,350		
Pend Nater Reaters						20.150	20,480		20,870
A - L-F closed heaters				,	,		•	,	
B - B - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	٠.			157,500	102,500	103,000	50,500	52,500	-
C - Deserting heater D - Insulation a. Closed heaters b. Degarating 9,400 9,000 8,400 8,200 Structural Mork a. For closed heaters b. For deserating heater 28,000 26,509 25,000 24,500 23,500						104,500			92,500
a. Closed heaters b. Dearcating 9,400 9,000 8,000 7,000 Structural Work a. For closed heaters b. For descrating heater 17,500 14,000 7,000 7,000 7,000				127,000	122,000	118,000	114,000	112,000	-
Deserating 9,400 9,000 8,000 8,400 8,200				7 100	5 100	2 650	2.100	_	_
E - Structural Work a. For closed heaters b. For deserating heater 28,000 26,500 25,000 24,500 23,500 - Boiler Feed Pumps a. Pumps and base plate 165,000 159,000 156,000 153,000 151,500 150,00 b. Fluid drive 121,500 96,000 96,000 96,000 96,000 96,000 96,000 96,000 c. Motors 248,830 236,705 214,875 197,235 184,890 184,00 d. Erection 22,500 20,700 19,500 18,300 17,700 17,40 e. Foundations for pumps 69,750 38,250 37,200 28,050 29,550 b. Motors 43,780 22,450 22,450 13,340 14,080 5. c. Erection 6,600 5,650 5,700 5,300 5,550 - Piping and Insulation a. Extraction steam b. Heater vents and drafns b. Heater vents and drafns c. Boiler feed piping d. Condensate piping a. From condensate pumps through L-P heaters b. For D-C heater and B.F. pump succion B.F. pump succion 19,000 19,000 17,100 17,100 17,100 17,10 Demineralizing Equipment and Condensate Storage Tanks Electridal TOTAL CONSTANT COST 19,1500 18,300 38,000 38,000 308,000 296,000 96,					9,000			8,200	-
a, For closed heaters b, For deserating heater 28,000 26,509 25,000 24,500 23,500 - Boiler Feed Pumps a, Pumps and base plate b, For deserating heater 165,000 159,000 156,000 153,000 151,500 150,00 c, Motors d, Bretion d, Bretion 22,500 20,700 19,500 18,300 17,700 18,40 d, Erection c, Poundarions for pumps 3, Pumps A, Pumps A, Pumps B, Pumps				.,					
Bolier Feed Pumps		a. For closed heaters		17,500		7,000		12 500	-
a. Pumps and base plate b. Fluid drive c. Motors d. Erection e. Poundations for pumps 22,500 2,7				28,000	26,500	25,000	24,500	23,300	-
121,500 96,000	•			165,000	159,000	156,000	153,000	151,500	150,000
C. Motors 248,830 236,705 197,235 184,890 184,00 17,400 17,400 17,400 17,400 17,400 18,400 17,400 17,400 17,400 18,400 17,400 17,400 17,400 17,400 17,400 18,						96,000	96,000		96,000
Second content of the state Second content Second content									184,00
Condensate Fumps								4 050	
a. Pumps		e. Foundations for pumps		5,230	4,800	4,500	4,200	4,030	3,,,
1,750	٠.			69 750	38.250	37.200	28.050	29.550	•
C. Brection 6,100 5,650 5,700 5,300 5,550 - Piping and Insulation a. Extraction steam b. Heater vents and drains c. Boiler feed piping d. Condensate piping a'. From condensate pumps b'. For D-C heater and B.F. pump suction e. Main steam 19,000 19,000 17,100 17,100 17,100 17,1 Demioralizing Equipment and Condensate Storage Tanks Electrical TOTAL TIEMS 1 - 11 TOTAL CONSTANT COST TOTAL TURBINE PLANT COST Piping in Containment Vessel 408,000 358,000 308,000 296,000 294,000 201,000 17,000 127,000 127,000 162,000 161,000 100,000 121,000 121,000 100,00 100,00 121,000 121,000 100,00 100,00 100,00 100,00 100,00 100,00 100,00 100,00 100,00 100,00 100,00 100,00 100,00 100,00 100,00 100,00 100,00 100,						22.450			
a. Extraction steam b. Reater vents and drains c. Boiler feed piping d. Condensate piping a'. From condensate pumps through L-P heaters b'. For D-C heater and B.F. pump suction e. Main steam 19,000 19,000 17,100 17,100 17,100 17,100 17,100 17,100 17,100 17,100 17,100 17,100 161,000 167,500 161,000 167,500 161,000 167,500 162,000 161,00 161,000 167,500 162,000 161,000 167,500 162,000 161,000 167,500 162,000 161,							5,300	5,550	-
a. Extraction steam b. Reater vents and drains c. Boiler feed piping d. Condensate piping a'. From condensate pumps through L-P heaters b'. For D-C heater and B.F. pump suction e. Main steam 19,000 19,000 17,100 17,100 17,100 17,100 17,100 17,100 17,100 17,100 17,100 17,100 161,000 167,500 161,000 167,500 161,000 167,500 162,000 161,00 161,000 167,500 162,000 161,000 167,500 162,000 161,000 167,500 162,000 161,		Piping and Insulation							
b. Reater vents and drafns (a Boiler feed plping 163,400 163,400 98,200 98,200 59,400 115,1 15,1 163,400 163,400 98,200 98,200 59,400 115,1 163,400 163,400 98,200 98,200 59,400 115,1 163,400 163,400 98,200 98,200 59,400 115,1 163,400 163,400 98,200 98,200 59,400 115,1 163,400 163,400 98,200 98,200 59,400 115,1 163,400 163,400 98,200 59,400 115,1 163,400 163,400 98,200 59,400 115,1 163,400 163,400 98,200 59,400 115,1 163,400 163,400 98,200 59,400 115,1 163,400 163,400 163,400 163,400 163,400 98,200 59,400 115,1 163,400 16		a. Extraction steam		201,000	178.800	147,000	127,200	81,000	47,90
A. Condensate piping a'. From condensate pumps through L.P heaters b'. For D-C heater and B.F. pump suction e. Main steam 19,000 19,000 17,100 17,100 17,100 17,1 Demioralizing Equipment and Condensate Storage Tanks Electrical Torbine Room Building Condenser Pit-Size Increment Toral TERMS 1 - 11 TOTAL CONSTANT COST 5,191,500 5,191,50			,			_ 1	98,200	59,400	115,10
a'. From condensate pumps through L.P heaters b'. For D-C heater and B.F. pump suction e. Main steam 19,000 19,000 17,100				105,400	100,100	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	,		•
b'. For D-C heater and B.F. pump suction e. Main steam 19,000 19,000 17,100 17,100 17,100 17,100 Demineralizing Equipment and Condensate 195,500 185,500 176,000 167,500 162,000 161,00 Storage Tanks Electrical 130,300 124,200 121,000 117,200 121,000 100,0 Torbine Room Building Condensar Pit-Size Increment 107AL ITEMS 1 - 11 14,955,280 14,729,225 14,541,375 14,453,000 14,443,205 14,514,55 TOTAL CONSTANT COST 5,191,500 5,191,500 5,191,500 5,191,500 5,191,500 5,191,500 20,146,780 19,920,725 19,732,875 19,644,500 19,634,705 19,704,0 Piping in Containment Vessel 408,000 358,000 308,000 296,000 294,0		a'. From condensate pumps)			[ća 200	
B.F. pump suction e. Main steam 19,000 19,000 17,100 17,100 17,100 17,100 Demineralizing Equipment and Condensate 195,500 185,500 176,000 167,500 162,000 161,0 Storage Tanks Electrical 130,300 124,200 121,000 117,200 121,000 100,0 Turbine Room Building Condenser Fit-Size Increment TOTAL CONSTANT COST 5,191,500			•	107,500	75,500	75,500	68,800	68,800	
19,000 19,000 17,100 167,500			_ {						
Demineralizing Equipment and Condensate 195,500 185,500 176,000 167,500 162,000 161,00 Storage Tanks 130,300 124,200 121,000 117,200 121,000 100,000 100,00 100,000 100,			,	19,000	19,000	17,100	17,100	17,100	17,10
Storage Tanks 130,300 124,200 121,000 117,200 121,000 100,0							167.500	162,000	161,00
Torbine Room Building Base State	•			233,500					
Condenser Fit-Size Increment 1,750 2,100 2,450 3,500 3,500 4,43,205 14,514,5 1,707AL TIEMS 1 - 11 14,955,280 14,729,225 14,541,375 14,453,000 14,443,205 14,514,5 1,500 1,500 5,191,500 5,191,500 5,191,500 5,191,500 5,191,500 5,191,500 5,191,500 5,191,500 1,91,500		Electrical .		130,300	124,200	121,000	117,200	121,000	100,00
Condenser Fit-Size Increment 1,750 2,100 4,453 3,500 4,453 250 10,11	١,	Turbine Room Building				 -1	Sase		
TOTAL CONSTANT COST 5,191,500 5,191,				1.750	2.100	2.450	3,500	5.250	10,10
TOTAL CONSTANT COST 5,191,300 5,191,300 3,191,	•	TOTAL ITEMS 1 - 11	1	4,955,280	14,729,225	14,541,37	14,453,000	14,443,205	14,514,55
Piping in Containment Vessel 408,000 358,000 330,000 308,000 296,000 294,0		TOTAL CONSTANT COST	_	5,191,500	5,191,500	2,171,20	, ,,,,,,,,,,,	3,191,500	
77 TOTAL OF THE TO		TOTAL TURBINE PLANT COST	2	0,140,780	19,920,723	1		•	
40 SEC TOD 40 070 70E 10 052 500 10 930 705 70 000 0	١.	Piping in Containment Vessel		408,000					294,00
WARRING A VACCE		GRAND TOTAL	2	0,554,780	20,278,725	20,062,87	19,952,500	19,930,705	20,000,05

SUMMARY OF COST DATA
1200 PSIA, 667 F THROTTLE STEAM
(100 F SUPERHEAT)
300 MWs INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	6	5 .	4	3	2	1
1. Turbine Generator and Accessories						
a. Turbine generator unit	8,920,000	8,920,000	8,920,000	8,920,000	8,920,000	8,920,000
b. Turbine generator erection	390,000	390,000	390,000	30,000	390,000	390,000
c. Reserve exciter		147 000		tant	167.000	167.000
d. Turbine foundation	167,000	167,000	167,000	157,000	167,000	167,000
 Condensers Shells and accessories) 813,500	827,000	840,500	857,500	908,000	989,000
b. Dry vacuum pumps)	,		1.,		
c. Tubes	457,500	465,000	472,500	487,500	510,000	555,000
d. Steam jet air equipment	19,250	19,250	19,250	17,500	17,500	33,250
 Erection Deseration - hot well of cond. 	138,000	139,000	140,000	144,000	150,000	162,000 44,500
g. L-P htrs. in exhaust stack	20,000	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System	,		•	'		
A - Structures						
a. Crib house)					
a'. Substructure)					
b'. Superstructure c'. Steel	{			İ		
d'. Miscellaneous	90,000	492,000	498,000	506,000	523,000	549,000
b. Dredging)					
c. Intake flume or forebay)			1		
d. Seal well	?]		
e. Discharge flume f. Outfall	3			į		
B - Crib House Equipment (erected	,					
a. Traveling screens)			i)		
b. Screen wash pumps)		100 000	1 200	140 000	150.000
c. Screen wash piping) 134,500	135,500	138,000	141,000	148,000	159,000
 d. Chlorination equipment e. Chlorine handling 	{					
C - Circulating Water Piping	489,000	491,000	495,000	500,000	512,000	530,500
D - Circulating Water Pumps	·					
a. Pumpe	196,000	197,000	201,000	206,000	217,000	234,000
b. Motors	148,000	149,000	151,000 19,200	153,500 19,500	159,000 20,200	168,000 21,300
c. Brection	18,900	19,000	19,200	19,500	20,200	21,300
Feed Water Heaters	153,500	96,500	97,500	48,500	50,000	_
A - L-P Closed Heaters B - H-P Closed Heaters	217,500	202,000	98,500	88,500	-,	89,500
C - Desersting Rester	118,000	114,000	111,000	108,500	107,000	-
D - <u>Insulation</u>						
a. Closed heaters	6,350	4,550	2,200	1,550	7 000	-
b. Deserating	8,700	8,350	8,200	8,000	7,900	-
E - Structural Work a. For closed heaters	17,500	14,000	7,000	7,000	-	-
b. For deserating heater	25,200	24,300	23,500	22,800	22,500	-
. Boiler Feed Pumps	•	•		1		
a. Pumps and base plate	158,500	154,500	153,000	150,500	149,500	148,000
b. Fluid drive	121,500	96,000	96,000	96,000	96,000	96,000
c. Motors	249,000	230,000	221,000	208,000	199,500 17,000	196,500 16,500
d. Erection	20,200 4,650	18,800 4,350	18,200 4,200	17,300 3,950	3,900	3,750
e. Foundations for pumps	4,050	4,350	4,200	3,550	2,,,,,	•,,
a. Pumps	61,200	34,400	35,100	26,000	27,600	-
b. Motors	38,800	20,400	20,700	12,700	13,300	-
c. Erection	5,600	5,200	5,300	5,000	5,300	-
7. Piping and Insulation						
a. Extraction steam) 201,000	178,800	147,000	127,200	81,000	47,900
b. Heater vents and drains	>				<i>(1.</i> 100	124 200
c. Boiler feed piping	161,200	161,200	102,600	102,600	64, 100	124,200
 d. Condensate piping a'. Brom condensate pumps 	{					
through L-P heaters	72,600	61,500	61,500	61,700	61,700	-
b', For D.C. heater and)	•				
B.F. pump suction)				10.000	12 000
e. Main steam	21,800	21,800	12,000	12,000	12,000	12,000
. Demineralizing Equipment and				140,000	160 000	155 000
Condensate Storage Tanks	191,000	178,000	171,000	163,000	160,000	155,000
. Electrical	129,500	123,100	123,100	118,400	118,400	102,200
. Turbine Room Building				ļ		_
a. Building	-	-	-	<u> </u>	-	-
b. Turbine generator sub-base	-	•	-	-	2 200	
. Condenser Pit-Size Increment	400	700	1,100	1,800	2,800	4,900
TOTAL ITEMS 1 - 11	14,385,350	14,183,200	13,991,150	13,920,500	13,851,200	13,929,000
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	19,576,850	19,374,700	19,182,650	19,112,000	19,042,700	19,120,500
2. Piping in Containment Vessel	271,500	271,500	279,200	279,200	279,200	278,700
GRAND TOTAL	19,848,350	19,646,200	19,461,850	19,391,200	19,321,900	19,399,200
GRAND TOTAL	17,040,330	19,040,100	,,	,,	,,	

SUMMARY OF COST DATA
1200 PSIA, 767 F THROTTLE STEAM
(200 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	6	5	4	3	2	1
Turbine Generator And Accessories	8,440,000	8,440,000	8,440,000	8,440,000	8,440,000	8,440,000
a. Turbine generator unit b. Turbine generator erection	390,000	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter		167.000	Cons 167,000	67,000	167,000	167,000
d. Turbine foundation	167,000	167,000	107,000	107,000	10,,000	,
Condensers a. Shells and accessories) 773,000	786,500	800,000	\$13,500	854,000	908,000
b. Dry vacuum pumps)		/ 50 000	L	480,000	510,000
c. Tubes	435,000 19,250	442,500 19,250	450,000 19,250	457,500 17,500	17,500	33,250
d. Steam jet air equipment e. Erection	132,000	134,000	136,000	38,000	142,000	150,000
f. Descration - hot well of cond.	None	20, 000	20,000	10,000	10,000	41,000 10,000
g. L-P htrs. in exhaust stack	20,000	20,000	20,000	10,000	10,000	
Circulating Water System A - Structures a. Crib house a'. Substructure b'. Superstructure c'. Steel d'. Miscellaneous b. Dredging c. Intake flume or forebay))) 472,000))	476,000	481,000	486,000	500,000	524,000
d. Seal well e. Discharge flume f. Outfall B - <u>Crib House Equipment (erected)</u> a. Traveling acreens b. Screen wash pumps c. Screen wash piping d. Chlorination equipment)))))))	129,000	131,000	133,000	139,000	148,500
e. Chlorine handling)				496,000	513,000
C - Circulating Water Piping D - Circulating Water Pumps	477,000	479,500	483,000	486,500 i	490,000	313,000
a. Pumps	184,000	187,000	190,000	193,000	202,000	218,00
b. Motors	142,000	143,500 18,300	145,000 18,500	147,000 18,700	151,500 19,300	159,50 20,30
c. Brection	18,100	10,300	10,500	10,700	15,500	,
Feed Water Heaters A - L-P Closed Heaters	145,500	93,000	93,000	46,000	47,500	•
B - H-P Closed Heaters	210,500	192,000	95,500	84,500		86,50
C - Deserating Heater	112,000	108,500	106,000	102,500	102,500	-
D - <u>Insulation</u> a. Closed heaters	6,000	4,200	2,100	1,500	-	-
b. Descrating	8,200	8,000	7,800	7,700	7,400	-
E - Structural Work a. For closed heaters	17,500	14,000	7,000	7,000	-	-
b, For deserating heater	23,700	22,800	22,200	21,700	21,400	-
Boiler Feed Pumps						
 Pumps and base plate 	154,500	151,500	150,000	147,500 96,000	147,000 96,000	146,00 96,00
b. Fluid drive c. Motors	96,000 222,000	96,000 213,000	96,000 199,500	189,000	181,500	180,50
d. Erection	18,800	17,700	17,100	16,400	16,200	15,70
e. Foundations for pumps	4,350	4,050	3,900	3,750	3,700	3,60
Condensate Pumps				a	26 200	
a. Pumps	55,600 35,500	31,700 18,900	32,200 19,200	24,000 11,900	25,300 12,400	-
b. Motors c. Erection	5,200	4,900	5,000	4,800	5,000	-
Piping And Insulation						
a. Extraction steam)		147.000	1127 200	81,000	47,90
b. Heater vents and drains c. Boiler feed piping) 201,000 161,200	177,500 129,900	147,000 102,600	127,200	64,100	124,20
d. Condensate piping)			1		
a'. From condensate pumps	72.600	61 500	61,500	61,700	61,700	-
through L-P heaters b'. For D.C. heater and) 72,600	61,500	31,550		•	
B.F. pump suction)			!	24 100	34,10
e. Main steam	41,200	41,200	36,900	34,100	34,100	34,10
Demineralizing Equipment And Condensate Storage Tanks	178,000	166,000	161,000	155,000	151,000	148,00
Electrical	125,000	122,700	119,200	114,900	114,900	93,90
Turbine Room Building	225,000		,	1	•	
a. Building		_	-	: •	-	-
b. Turbine Generator sub-base	=	-	-			
Condenser Pit-Size Increment	-	-	-	400	1,400	2,80
TOTAL ITEMS 1 - 11	13,691,300	13,511,600	13,355,450	13,257,850	13,182,400	13,211,75
TOTAL CONSTANT COST	5,191,500	191,500 ذ	5,191,500	5,191,500	5,191,500	5,191,50 18,403,25
TOTAL TURBINE PLANT COST	18,882,800	18,703,100	18,546,950	18,449,350 328,500	18,373,900 328,500	328,00
Piping In Containment Vessel	365,100	402,600	332,700			-
GRAND TOTAL	19,247,900	19,105,700	18,879,650	18,777,850	18,702,400	18,731,25

SUMMARY OF COST DATA
1200 FSIA, 867 F THROTTLE STEAM
(300 F SUPERHEAT)
300 MM= INDIRECT CYCLE TURBINE PLANT

Tarbliss Generators and Accessories 30,000 7,510,000 300,0								
a. Turbing generator unit b. Turbing generator unit b. Turbing generator unit b. Turbing generator b. Turbing generator d. Turbing toundation d. Turbing t	HEATER ARRANGEMENT		6	. 5	4		4	
b. Turbine generator sweetion c. Paserve watter d. Turbine foundation 107,000 167,000	1. Turbine Generator and Accessories		. 610 000	7 810 000	7 810 000	000 044.8	8.440.000	8.440.000
C. Beserve Sexter d. Turbine foundation 107,000 167,000 167,000 157,000 167,000 187,00					390,000	390,000		
d. Turbine foundation 167,000					Constant -			
## Shell' end Accessories 719,000 735,500 745,000 425,000 450,000			167,000	167,000	167,000	167,000	167,000	167,000
## Shell' end Accessories 719,000 735,500 745,000 425,000 450,000	2. Condensers							
C. Tubbe 10,200 112,500 121,500 121,500 131,000 135,000 136,			719,000	732,500	746,000	759,500	800,000	854,000
19.250 19.250 19.250 17.500 17.500 13.000 1)	/AE AAA	412 500	420,000	427 500	450.000	480,000
Treation 124,000 126,000 134,000 134,000 136								
### Special Control will of cond. None 20,000 20,000 10,00						130,000		142,000
S. L.P. https://dx.com/linearizestack 20,000 20,000 20,000 10,000								
A - Structures			20,000	20,000	20,000	10,000	10,000	10,000
a. Crib house a. Substructure b. Superstructure b. Superstructure c. Superstructure d. Mixel lancous d. Mixel lancous d. Mixel lancous d. Mixel lancous d. Mixel lancous d. Mixel lancous d. Mixel lancous d. Mixel lancous d. Survey lancous d. Surve	3. Circulating Water System							
a'. Substructure b'. Superscructure c'. Steel d'. Miscallaneous d'. Miscallaneous d'. Miscallaneous d'. Miscallaneous d'. Miscallaneous d'. Miscallaneous d'. Miscallaneous d'. Miscallaneous d'. Miscallaneous d'. Steel d'. Miscallaneous d'. Steel d'. Miscallaneous d'. Steel d'. Miscallaneous d'. Steel d'. Miscallaneous d'. Steel d'. Miscallaneous d'. Steel d'. Miscallaneous d'. Steel d'. Miscallaneous d'. Steel d'. Steel d'. Miscallaneous d'. Steel d'.								
b'. Superstructure c'. Steel d'. Hiscellancous b. Dredging do forbaby d. Seal well c. Discharge fitume b. Dredging do forbaby d. Seal well c. Discharge fitume b. Dredging do forbaby d. Seal well c. Discharge fitume b. Dredging do forbaby d. Seal well c. Discharge fitume b. Dredging do forbaby d. Seal well c. Discharge fitume b. Dredging do forbaby d. Duffall d. Chlorination equipment c. Screen wesh pumps d. Chlorination equipment d. Chlorination equipment d. Chlorination equipment d. Chlorination equipment d. Chlorination equipment d. Chlorination description d. Chlorination description d. Chlorination description d. Chlorination equipment de Chlorination description d. Chlorination d. Chlorination description d. Chlorination description d. Chlorination description d. Chlorination description d. Chlorination d. Chlorination description d. Chlorination description d. Chlorination description d. Chlorination description d. Chlorination d. Chlorination description d. Chlorination description d. Chlorination description d. Chlorination description d. Chlorination d. Chlorination description d. Chlorination description d. Chlorination description d. Chlorination description d. Chlorination d.								
c. Steel d. Miscellancous b. Dredging c. Intestel (lume or forebay) d. Seal well f. Outfall b. Crith Rouse Equipment (erected) a. Traveling excress b. Scress wash pipings c. Scress wash pipings c. Scress wash pipings c. City clutten Mater Pipings b. Chilorine handling c. City clutten Mater Pipings b. Coliorine handling c. City clutten Mater Pipings b. Scress wash pipings c. City clutten Mater Pipings b. Coliorine handling c. City clutten Mater Pipings b. Scress wash pipings c. City clutten Mater Pipings b. Scress wash pipings c. City clutten Mater Pipings b. Scress wash pipings c. City clutten Mater Pipings b. Scress wash pipings c. City clutten Mater Pipings b. Scress wash pipings c. City clutten Mater Pipings b. Materia c. Scress wash pipings c. City clutten Mater Pipings b. Materia c. Scress wash pipings c. Scress wash pipings c. City clutten Mater Pipings c. Scress wash pipings c. City clutten Mater Pipings c. Scress wash pipings c. Scress wash pipings c. City clutten Mater Pipings c. Scress wash pipings c. Scress wash pipings c. Scress wash pipings c. Scress wash pipings c. Scress wash pipings c. Scress wash pipings c. Scress wash pipings c. Scress wash pipings c. Scress wash pipings c. Scress wash pipings c. Scress wash pipings c. Scress wash pipings c. Scress wash pipings c. Scress wash pipings c. Scress wash pipings c. Scress wash pipings c. Wash pipings c. Scress wash pipings c. Wash piping			455,000	458,000	461,000	469,000	481,000	501,500
d'. Hiscallaneous		í	•			ļ		
c. Intake fitume or forebay d. Seal well e. Discharge fitume fourtain)				-		
d. Seal well e. Discharge fitume f. Outfall b. Green well pumps c. Screen well pumps d. Condensate pumps d. Screen well pumps d. Screen well pumps d. Screen well pumps d. Screen well pumps d. Screen well pumps d. Screen well pumps d. Condensate pumps d. Screen well pumps d. Condensate pumps d. Screen well pumps d. Condensate pumps d. Screen well pumps d. Condensate pumps d. Screen well pumps d. Screen well pumps d. Screen well pumps d. Screen well pumps d. Screen wel)						
## Discharge flume		,						
## Courtail ## Co		ί.						
8 - Crits Nove Equipment (erected) 8. Traveling screens 120,000 121,500 123,000 126,000 131,000 139,500 9. Screen wash pumps 0. C. Screen wash plying 0. Chlorine handling 0. Chlorine han						1		
Description 120,000 121,500 123,000 126,000 131,000 139,500						1		
Sersen wash piging	a. Traveling screens			101 500	122 000	126 000	131 000	139,500
d. Chlorina tand ling c. C. Circulating Water Figing D. C. Circulating Water Figing D. Water Hall Circulation D. Water Water and drains C. Boiler feed piping D. Circulating Water Figing D. Water Water and Circulation D. Water State Figing D. Water Circulating Water Figing D. Water Circulation D. Water Circulation D. Water Circulation D. Water Circulation D. Water Circulation D. Water Circulation D. Water Circulation D. Water Circulation D. Water Circulation D. Water Circulation D. Water Circulation D. Water Circulation D. Water Circulation D. Water Circulation D. Water Circulation D. Water Circulation D. Water Circulation D. Water Circulation D. Water Circulation D.			120,000	121,300	123,000	120,000	131,000	257,500
e. Chlorine handling C. <u>Circulating Water Pinns</u> D. <u>Circulating Water Pinns</u> D. P. <u>Circulating Water Pinns</u> D. P. <u>Circulating Water Pinns</u> D. P. <u>Circulating Water Pinns</u> D. P. <u>Circulating Water Pinns</u> D. P. <u>Circulating Water Pinns</u> D. P. <u>Circulating Water Pinns</u> D. P. <u>Circulating Water Pinns</u> D. P. <u>Circulating Water Pinns</u> D. P. <u>Circulating Water Pinns</u> D. P. <u>Circulating Water Pinns</u> D. P. <u>Circulating Water Pinns</u> D. P. <u>Circulating Water Pinns</u> D. P. <u>Circulating Water Pinns</u> D. P. <u>Circulating Water Pinns</u> D. P. <u>Circulating Waters</u> D. P. <u></u>						-		
C - Circulating Water Pioing B - Circulating Water Pioing a. Pumps b. Motors c. Erection 17, 000 175,000 177,000 182,000 190,000 203,000 b. Motors c. Erection 17, 000 175,000 177,700 182,000 181,000 181,500 181,500 193,000 203,000 c. Erection 17, 000 175,000 177,700 182,000 181,000 181,500 181,500 193,000 203,000 c. Erection 17, 000 175,000 177,700 182,000 182,000 181,500 181,500 183,000 203,000 c. Erection 17, 000 17, 000 182,000 182,000 183,000 183,000 183,000 183,000 183,000 184								
D		•	464,500	467,000	469,000	474,500	483,000	497,500
142,000						100 000	100.000	202 000
17,400 17,500 17,700 18,000 18,500 19,300 19,300 18,500 19,300 18,500 19,300 18,500 19,300 18,500 19,300 18,500 19,300 18,500 19,300 18,500 19,300 10,300 19,300 1								
## Nead Hattif Heakers								19,300
A - L-P Closed Heaters	3		17,400	17,500	114:100	-,,,,,,	,	
197,500			160.000	99 700	89 000	44, 500	46,000	-
107,000 104,000 102,000 100,000 99,000 -	A - L-P Closed Heaters						-	84,000
D Insulation No.							99,000	- '
a. Closed heaters				•	•			
R - Structural Work							7 300	-
A. For closed heaters b. For deserating heater 22,500 21,800 21,800 21,800 20,900 20,600 - 5. Boiler Feed Pumps a. Pumps and base plate b. Fluid drive 96,000 96,000 98,0			7,900	7,700	7,500	7,400	7,300	-
b. For deserating heater 5. Boiler Feed Pumps a. Pumps and base plate b. Fluid drive c. Motors d. Exection e. Foundations for pumps 6. Condensate Pumps a. Pumps a. Pumps b. Fluid drive c. Motors d. Exection e. Foundations for pumps 6. Condensate Pumps a. Pumps b. Motors c. Treation c. Exection e. Foundations for pumps 6. Condensate Pumps a. Pumps b. Motors c. Exection d. Exection d. Exection d. Exection d. Exection e. Foundations for pumps 6. Condensate Pumps a. Pumps b. Motors d. Exection d. Exectio	E - Structural Work		17 500	16 000	7 000	7.000		-
5. Boller Feed Pumps a. Pumps and base plate b. Fluid drive 96,000 162,000 162,000 155,000 11,200 11							20,600	-
a. Pumps and base plate b. Fluid drive b. Fluid drive c. Motors d. Exection c. Motors d. Exection d. Exection c. Motors d. Exection d. Exection c. Motors d. Exection d. Exect			24,0-1		•			
b. Fluid drive c. Motors d. Erection 17,800 16,800 194,000 182,500 175,500 15,500 15,100 202,000 194,000 182,500 175,500 15,500 15,100 202,000 194,000 182,500 175,500 15,500 15,100 202,000 203,700 203,500 2			151,500	149,000	147,500	145,500	145,000	
C. Notors 1202,000 194,000 182,500 173,500 185,500 185,100 1				96,000				
e. Foundations for pumps 4,100 3,850 3,700 3,550 3,500 3,450 6. Condensate Pumps a. Pumps b. Motors c. Erection 32,800 17,600 17,900 11,200 11,700 - c. Erection 4,700 4,700 4,700 11,500 4,700 - 7. Piping and Insulation a. Extraction steam b. Heater vents and draine c. Boiler feed piping d. Condensate piping b. From condensate pumps chru L-P heaters b'. For D.C. heater and B.P. pump suction b. Heater seam 4,700 47,200 47,200 47,200 57,200 55,600 - b'. For D.C. heater and B.P. pump suction b. Heaters b'. For D.C. heater and B.P. pump suction condensate Storage Tanks 168,000 158,000 153,000 148,000 145,000 142,000 7. Electrical 10. Turbine Room Building a. Building a. Building a. Building b. Turbine generator sub-base 11. Condenser Pit-Size Increment TOTAL ITEMS I - 11 12,811,850 12,670,900 12,528,850 13,074,950 13,009,400 13,009,000 12,000 381,900 18,230,200 18,1400 18,1								167,000
6. Condensate Pumps a. Fumps b. Motors c. Erection c.								3 450
8. Fumps b. Motors c. Erection 4,900 4,700 17,500 11,700 1	e. Foundations for pumps		4,100	3,850	3,700	9,550	3,500	3,430
b. Motors c. Erection d. 4,900 d. 7,000			F1 100	20 200	20.000	22 600	23 500	_
C. Erection C. Erection C. Erection C. Erection C. Erection C. Erection C. Erection C. Erection C. Erection C. Erection C. Erection C. Erection C. Erection C. Erection C. Erection C. Erection C. Define and Lineulation C. Boiler feed piping C. Boiler feed piping C. Boiler feed piping C. Boiler feed piping C. Condensate piping C. Boiler feed piping C. Boile feed piping C. Boiler feed piping C. Boiler feed piping C. Boiler feed piping C. Boiler feed piping C. Boile feed piping C. Boiler feed piping C. Boile feed piping C. Boile feed piping C. Boile feed piping C. Boile feed piping C. Boile feed piping C. Boile feed piping C. Boile feed piping C. Boile feel piping C. Boile feel piping C. Boile feel piping C. Boile feel piping C. Boile feel piping C. Boile feel piping C. Boile feel piping C. Boile feel piping C. Boile feel piping C. Boile feel piping C. Boile feel piping C. Boile feel piping C. Boile feel piping C. Boile feel piping C. Boile feel piping C. Boile feel piping C. Boile feel piping C. Boile feel piping C. Boile feel piping C. Boile								-
7. Piping and Insulation a. Extraction steam b. Heater vents and drains c. Boiler feed piping d. Condensate piping d. Condensate piping chru L-P heaters b. F. pump suction e. Main steam Desing reliable Storage Tanks 168,000 158,0					4,700		4,700	-
a. Extraction steam b. Heater vents and draine c. Boiler feed piping d. Condensate piping c. From condensate pumps chru L-P heaters b'. For D.C. heater and B.P. pump suction c. Main steam 47,200 47			.,	.,	•••	1	•	
b. Heater vents and drains c. Boiler feed piping d. Condensate piping a'. From condensate pumps b'. For D.C. heaters b'. For D.C. heaters d. E.F. pump suction e. Main steam 8. Demineralizing Equipment and Condensate Storage Tanks 9. Electrical 10. Turbine Room Building a. Building b. Turbine generator sub-base 11. Condenser Fit-Size Increment 10. Total ITEMS 1 - 11 10. Total CONSTANT COST 10. Piping in Containment Vessel 11. Containment Vessel 11. Containment Vessel 12. Piping in Containment Vessel 11. Piping in Containment Vessel 11. Condenser FitAnt COST 12. Piping in Containment Vessel 13. Condenser PitAnt COST 13. Condenser PitAnt COST 13. Condenser PitAnt COST 13. Containment Vessel 13. Containment Vessel 13. Containment Vessel 13. Condenser PitAnt COST 13. Containment Vessel 13. Containment Vessel 13. Containment Vessel 13. Containment Vessel 13. Condenser PitAnt COST 13. Containment Vessel 13. Containment Vessel 14. Containment Vessel 15. Condenser PitAnt COST 18. Containment Vessel 18. Containment Vessel 18. Containment Vessel 18. Containment Vessel 18. Containment Vessel 18. Containment Vessel 18. Containment Vessel)	200,600	171,900	147,000	111,500	76,300	47,900
129,900 129,900 102,600 102,600 64,100 124,200 d. Condensate piping 129,900 129,900 102,600 102,600 64,100 124,200 a'. From condensate pumps 172,600 61,500 61,500 57,200 55,600 b'. For D.C. heater and 18. From the policy of the policy							4	164 555
d. Condensate piping a'. From condensate pumps thru L-P heaters b'. For D.C. heater and B.F. pump suction e. Main steam 47,200 47,200 47,200 47,200 47,200 47,200 47,200 8. Demineralizing Equipment and Condensate Storage Tanks 168,000 158,000 153,000 148,000 145,000 142,000 9. Electrical 10. Turbine Room Building a. Building b. Turbine generator sub-base 110,000 140,000 140,000 140,000 140,000 110,800 144,900 114,900 114,900 114,900 110,800 144,900 114,900 114,900 114,900 110,800 146,900 114,900 114,900 114,900 114,900 110,800 114,900			129,900	129,900	102,600	102,600	64, 100	124, 200
thru L-P heaters	d. Condensate piping	,						
b'. For D.C. heater and B.F. pump suction e. Main steam 47,200 47		~	72 500	61 500	61 500	57.200	55,600	_
B.F. pump suction e. Main steam 47,200 47,200 47,200 47,200 47,200 47,200 47,200 47,200 47,200 8. Demineralizing Equipment and Condensate Storage Tanks 9. Electrical 116,700 114,300 110,800 114,900 114,900 114,900 90,300 10. Turbine Room Building a. Building b. Turbine generator sub-base 11. Condenser Fit-Size Increment 11. Condenser Fit-Size Increment 12. A condenser Fit-Size Increment 13. A condenser Fit-Size Increment 14. TOTAL ITEMS I - 11 15. A condenser Fit-Size Increment 15. A condenser Fit-Size Increment 16. A condenser Fit-Size Increment 17. A constant COST 18.003,350 17,862,400 17,720,350 18,266,450 18,200,900 18,230,200 12. Piping in Containment Vessel 18. A condenser Fit-Size Increment 18. A condenser Fit-Size Increment 18. A condenser Fit-Size Increment 19. A condenser Fit-Size Increment 29. A		ζ.	72,000	51,500	01,300	1,,200	25,000	
e. Main steam 47,200 47								
8. Demineralizing Equipment and Condensate Storage Tanks 168,000 158,000 153,000 148,000 145,000 142,000 9. Electrical 116,700 114,300 110,800 114,900 114,900 90,300 10. Turbine Room Building a. Building b. Turbine generator sub-base -1,000 -1,000 -1,000 -1,0000		•	47,200	47,200	47,200	47,200	47,200	47,200
Condensate Storage Tanks 168,000 158,000 153,000 148,000 149,000								
9. Electrical 116,700 114,300 110,800 114,900 114,900 90,300 10. Turbine Room Building a. Building b. Turbine generator sub-base -1,000 -6,400 -6,400 -1,0000	Condensate Storage Tanks		168,000	158,000	153,000	148,000	145,000	142,000
10. Turbine Room Building a. Building b. Turbine generator sub-base -1,000 -1,0				114.300	110.800	114,900	114,900	90,300
a. Building b. Turbine generator sub-base -1,000 -1			,,,,,,	,		1.	-	
b. Turbline generator sub-base -1,000			-6 600	-6 400	-6 400	4	_	_
11. Condenser Pit-Size Increment TOTAL ITEMS 1 - 11 12.811,850 12.670,900 12.528,850 13.074,950 13.009,400 13.038,700 5,191,500 5,191,500 5,191,500 5,191,500 5,191,500 5,191,500 18.266,450 18.200,900 18.230,200 12. Piping in Containment Vessel 384,500 384,500 384,500 381,900 381,900 381,900 381,400 381,400	a. Bulidiag					1	-	-
TOTAL TURBINE FLANT COST 18,003,350 17,862,400 17,720,350 18,266,450 18,200,900 18,230,200 12. Piping in Containment Vessel 384,500 384,500 381,900 38					-,	4	_	2,500
TOTAL TURBINE FLANT COST 5,191,500 5	-				-		1 . 000 600	
TOTAL TURBINE PLANT COST 18,003,350 17,862,400 17,720,350 18,266,450 18,200,900 18,230,200 12. Piping in Containment Vessel 384,500 384,500 381,900 381,900 381,900 381,400			12,811,850					•
10 TOTAL TURBING FLANK COST 18,000,530 1,384,500 381,9	TOTAL CONSTANT COST		5,191,500	5,191,500	5,191,500			
12. Piping in Containment Vessel 384,500 384,500 381,900 381,900 381,900 381,900 381,600	TOTAL TURBINE PLANT COST		18,003,350	17,862,400	17,720,350	18,266,450	18,200,900	18,230,200
12, Fighting In contestiments viewed.					381,900	381,900	381,900	381,400
GRAND ICIAL 10.007,000 AC, 240,700 AC, 240								18,611,600
	GRAND TUTAL		10,00,,000	.0, 240, 700	,,			

SUMMARY OF COST DATA 1200 PSIA, 967 F THROTTLE STRAM (400 F SUPERHEAT) 300 MWe INDIRECT CYCLE TURBINE PLANT

_	HEATER ARRANGEMENT	6	5	4	3	2	i
1.	Turbine Generator and Accessories			i			
	a. Turbine generator unit b. Turbine generator erection	8,050,000 390,000	8,050,000 390,000	8,050,000 390,000	8,050,000 390,000	8,050,000 390,000	8,680,000 390,000
	c. Reserve exciter		3,0,000	Coh	stant		\longrightarrow
	d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000
2	Condensers			705 500	706 500	264 000	900 000
	a. Shells and accessories b. Dry vacuum pumps) 678,500	692,000	705,500	705,500	746,000	800,000
	c. Tubes	382,500	390,000	397,500	397,500	420,000	450,000
	d. Steam jet air equipment	19,250	19,250	19,250	17,500	17,500	17,500 136,000
	e. Erection f. Deseration - hot well of cond.	118,000 None	120,000	122,000	122,000	128,000	36,000
	g. L-P htrs. in exhaust stack	20,000	20,000	20,000	10,000	10,000	10,000
3.	Circulating Water System						
	A - Structures						
	a, Crib house a'. Substructure)		į			
	b'. Superstructure	9 439,000	442,000	446,000	450,000	463,000	484,000
	c'. Steel	?					
	d'. Miscellaneous b. Dredging	{					
	c. Intake flume or forebay	Ś					
	d. Seal well)					
	e. Discharge flume f. Outfall) }					
	B - Crib House Equipment (erected)	•					
	a. Traveling screens)	115 000	116 500	118 500	123 500	132,000
	b. Screen wash pumpsc. Screen wash piping) 113,500	115,000	116,500	118,500	123,500	152,000
	d. Chlorination equipment	Ś					
	- ·) 453,500	AES 500	.se soo	441 500	470,000	485,000
	C - Circulating Water Piping D - Circulating Water Pumps	433,300	455,500	458,500	461,500	470,000	403,000
	a. Pumps	162,000	164,000	167,000	170,000	178,000	192,000
	b. Motors	131,000 16,800	132,000	133,500	135,000 17,200	139,000 17,700	146,000 18,600
	c. Erection	10,000	16,900	17,100	11,5200	17,700	10,000
4.	Feed Water Heaters A - L-P Closed Heaters	133,000	85,500	86,000	43,000	44,500	-
	B - H-P Closed Heaters	190,000	178,000	87,500	80,000	-	81,500
	C - Deserating Hester	103,000	100,500	98,500	97,000	96,000	-
	D - Insulation a. Closed heaters	5,150	3,700	1,800	1,300	-	
	b. Deaerating	7,600	7,400	7,300	7,200	7,200	•
	E - Structural Work		1/ 000	7.000	7 000		
	a. For closed heaters b. For deserating heater	17,500 21,500	14,000 20,900	7,000 20,500	7,000 20,200	20,000	-
		,			•	•	
٠.	Boiler Feed Pumps a. Pumps and base plate	149,000	146,500	145,500	144,000	143,500	142,500
	b. Fluid drive	96,000	96,000	96,000	96,000	96,000	96,000
	c. Motors	185,000 16,900	178,500 16,000	169,000 15,600	161,000 15,100	156,500 14,900	156,000 14,600
	d. Erection e. Foundations for pumps	3,850	3,650	3,550	3,450	3,400	3,300
6.	Condensate Pumps	•					
٧.	a. Pumps	47,300	27,200	27,700	20,900	22,000	-
	b. Motors	30,500 4,600	16,500	16,800	10,600 4,300	11,000 4,500	- :
_	c. Erection	4,600	4,500	4,500	4,500	4,500	_
7.	Piping and Insulation s. Extraction steam)		1			
) 198,400	171,400	147,000	111,500	76,300	47,900
	c. Boiler feed piping	129,900	129,900	102,600	102,600	64,100	124,200
	d. Condensate piping a'. From condensate pumps	`					
	thru L-P heaters	Ś					
	b'. For D.C. heater and) 68,000	57,000	55,600	55,600	55,600	-
	B.F. pump suction e. Main steam) 55,200	55,200	55,200	55,200	55,200	55,200
	Demineralizing Equipment and			- 1	<u>-</u>	•	
ν.	Condensate Storage Tanks	159,000	150,000	147,000	142,000	140,000	137,000
9.	Electrical	112,400	110,800	110,800	106,000	106,400	90,300
	Turbine Plant Building	•	•	-	•	•	-
	a. Building	-6,400	-6,400	-6,400	-6,400	-6,400	-
	b. Turbine generator sub-base	-1,000	-1,000	-1,000	-1,000	-1,000	-
11.	Condenser Pit-Size Increment	•	-	-	-	-	-
	TOTAL ITEMS 1 - 11	12,867,450	12,739,400	12,607,900	12,488,250	12,429,400	13,092,600
	TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
	TOTAL TURBINE PLANT COST	18,058,950	17,930,900	17,799,400	17,679,750	17,620,900	18,284,100
12		404,700	404,700	402,100	402,100	402,100	401,600
14.	Piping in Containment Vessel	18,463,650	18,335,600	18,201,500	18,081,850	18,023,000	18,685,700
	GRAND TOTAL	10,000,000	10,333,000	10,101,700	10,001,000	10,043,000	10,000,100

SUMMARY OF COST DATA 1000 PSIA, 545 F THROTTLE STEAM (SATURATED STEAM) 300 MWW INDIRECT CYCLE TURBINE PLANT

THROTTLE FLOW, #/HR.		4,337,000	4,014,000	3,708,000	3,471,000	3,316,000	3,060,000
HEATER ARRANGEMENT		6	5	4	3	2	ı
				<u> </u>			
a. Turbine Generator and Accessories a. Turbine generator unit		9,240,000	9,240,000	9,240,000	9,240,000	9,240,000	9,240,000
b. Turbine generator erection		390,000	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter		167 000	167 000	167,000	167,000	167,000	167,000
d. Turbine foundation		167,000	167,000	107,000	10,,000	20.,000	201,000
. Condensers)	908,000	921,500	948,500	975,500	1,029,000	1,116,000
a. Shells and accessories b. Dry vacuum pumps	Ś	700,000	,,		1		
c. Tubes	•	510,000	517,500	532,500	547,500	577,500	800,800
d. Steam jet air equipment		19,250	19,250	19,250 156,000	17,500	17,500 168,000	31,500 171,500
e. Erection f. Deaeration - hotwell of cond.		150,000	152,000	130,000	100,000		46,500
g. L.P. htrs. in exhaust stacks		20,000	20,000	20,000	10,000	10,000	10,000
. Circulating Water System							
A - Structures							
a. Crib house)						
a'. Substructure b'. Superstructure	Ś				İ		
c'. Steel)						*** 000
d'. Miscellaneous)	524,000	528,000	535,000	547,000	570,500	556,000
b. Dredging)				į		
c. Intske flume d. Seal well	3						
e. Discharge flume	Ś						
f. Outfall)						
B - Crib House Equipment (Erected))						
a. Traveling screens b. Screen wash pumps	3						
c. Screen wash piping	ś	148,000	150,000	153,000	157,000	166,800	161,000
d. Chlorination equipment)						
e. Chlorine handling)	#10.000	513,000	518,000	526,000	543,500	533,000
C - <u>Circulating Water Piping</u> D - <u>Circulating Water Pumps</u>		510,000	313,000	310,000	320,000	,	,
a. Pumps		216,125	218,975	223, 725	231,325	247,000	235,500
b. Motors		158,705	160, 200	162,665	166,360	174, 200	180,000
c. Erection		20, 150	20,330	20,630	21,110	22,000	21,500
. Feed Water Heaters					F1 F00	E2 E00	
A - L-P closed heaters		148,000	103,500 197,000	104,000 91,500	51,500 83,000	53,500	87,500
B - H-P closed heaters C - Descrating heater		216,000 126,000	122,900	118,000	114,000	112,000	0.1500
D - Insulation		220,000					
a. Closed heaters		6,600	4,800	2,150	1,500		-
b. Deserating		9,300	9,000	8,700	8,400	8,200	-
E - Structural Work a. For closed heaters		17,500	14,000	7,000	7,000	-	-
b. For descrating heater		27,500	26,500	25,500	24,500	23,500	-
. Boiler Feed Pumps							
a, Pumps and base plate		150,000	145,500	142,500	139,500	138,000	135,000
b. Fluid drive		96,000	96,000 199,440	96,000 182,460	96,000 169,875	96,000 160,410	96,000 150,930
c. Motors d. Erection		209,365 19,500	18,300	17,400	16,500	17,400	15,000
e. Foundations for pumps		5,100	4,800	4,500	4,200	4,050	3,900
. Condensate Pumpe		•					
a. Pumps		53,250	39,000	39,300	28,800	30,300	-
b. Motors		32,710	21,370	21,640	13,810	14,350	-
c. Erection		5,500	5,750	5,750	5,450	5,650	•
. Piping and Insulation					1		
 Extraction steam Heater vents and drains)	192,700	170,400	138,700	127,200	81,000	43,200
c. Boiler feed piping	,	132,100	132,100	83,500	83,500	53,000	98,200
d. Condensate piping		•					
a'. From condensate pumps thru)				1		
L.P. heaters)	107,500	75,500	75,000	68,800	68,800	-
b'. For D.C. heater and B.F. pump suction	, í						
e. Main steam	•	23,500	22,600	20,700	19,000	19,000	19,000
We discussed and an Woodness and		•			1		
Condensate Storage Tanks		193,000	184,000	175,000	168,500	164,000	157,000
. Electrical		123,400	121,700	118,700	114,700	116,400	91,700
				Base			
. Turbine Room Building					4 550	5 600	11 500
. Condenser Pit-Size Increment		2,800	3, 150	3,850	4,550	5,600	11,500
TOTAL ITEMS 1 - 11		14,878,255	14,733,865	14,567,820	14,506,280	14,455,710	14,568,930
TOTAL CONSTANT COST		5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST			19,925,365	19,759,320	19,697,780	19,647,210	19,760,430
TOTAL TORDING PARMY COST				256,000	252,000	250,000	252,000
. Piping in Containment Vessel GRAND TOTAL		316,000	276,000 20,201,365	20,015,320	19,949,780	19,897,210	20,012,430

1000 PSIA, 645 F THROTTLE STEAM (100 F SUPERREAT) 300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	6 -	5	44	3	2	1
1. Turbine Generator and Accessories						
a. Turbine generator unit	8,920,000		8,920,000	8,920,000	8,920,000	8,920,000
b. Turbine generator erection c. Reserve exciter	390,000	390,000	390,000 ——— Cons	390,000	390,000	390,000
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000
2. Condensers				ŀ		
a. Shells and accessories) 854,000	854,000	881,000	908,000	935,000	1,016,000
b. Dry vacuum pumps	}					
c. Tubes	480,000 19,250	480,000 19,250	495,000	510,000	525,000 17,500	570,000 31,500
d. Steam jet air equipment e. Erection	142,000	142,000	19,250 146,000	17,500 150,000	17,500 154,000	31,500 166,000
f. Deseration - hot well of cond.	None					45,600
g. L-P htrs. in exhaust stack	20,000	20,000	20,000	10,000	10,000	10,000
Circulating Water System A - Structures a. Grib house a'. Substructure	}					
b'. Superstructure c'. Stee! d'. Miscellaneous b. Dredging c. Intake flume or forebay) 502,000))	504,000	510,000	520,000	534,000	560,000
d. Seal well e. Discharge flume f. Outfall B - Crib House Equipment (eracted) a. Traveling screens)))					
 Screen wash pumps Screen wash piping Chlorination equipment Chlorine handling) 140,000))	140,000	143,000	147,000	153,000	163,000
C - <u>Circulating Water Piping</u> D - <u>Circulating Water Pumps</u>	498,000	499,000	503,000	510,000	520,000	538,000
a. Pumps	204,000	205,000	209,000	215,000	224,000	241,000
b. Motors	152,500	143,000	155,000	158,000	163,000	171,500
c. Erection	19,350	19,450	19,700	20, 100	20,700	21,700
Feed Water Heaters						
A - L-P Closed Heaters	148,000	97,500	98,500	49,000	50,700	-
B - H-P Cloyed Heaters	201,000	184,000	87,500	80,500		87,000
C - Descrating Heater D - Insulation	117,500	114,000	111,000	109,000	108,000	•
a. Closed heaters	6,100	4,300	2,000	1,400	_	_
b. Descrating	8,600	8,400	8,200	8,000	7,900	-
E - Structural Work					•	
a. For closed heaters	17,500	14,000	7,000	7,000		-
b. For desersting heater	25,100	24, 200	23,500	23,000	22,600	-
Boiler Feed Pumps						
s. Pumps and base plate b. Fluid drive	144,000	140,500	139,000	137,000	136,000	134,500
c. Motors	96,000 222,000	96,000	96,000	96,000	96,000	96,000
d. Erection	17,800	206,500 16,800	193,000 16,300	184,000 15,700	176,500 15,400	175,500 15,000
e. Foundations for pumps	4,600	4,300	4,150	4,000	3,950	3,800
Condensate Pumps	•	•	,	1	-,	•,•
a. Pumps	46,200	34,900	35,550	27,000	28,400	_
b. Motors	33,700	19,500	19,800	13,000	13,600	-
c. Brection	5,600	5,300	5,400	5,200	5,300	-
Piping and Insulation				8		
	192,700	170,400	138,700	127,200	81,000	43,200
c. Boiler feed piping	135,000	135,000	102,600	87,700	64, 100	105,000
d, Condensate piping),	155,000	101,000	07,700	04, 200	105,000
a'. From condensate pumps thru L-P heaters b'. For D.C. heater and		61,500	61,500	61,700	61,700	-
B.F. pump suction e. Main steam		15 000	15 000	15 000	16 000	15 000
	16,100	15,000	15,000	15,000	15,000	15,000
Demineralizing Equipment and Condensate Storage Tanks	188,000	176,000	171,000	164 000	161 000	163 000
Electrical	125,100			164,000	161,000	157,000
Turbine Room Building a. Building	Base	119,600 Base	119,600 Base	114,900 Base	119,700 Base	98, 700 Base
b. Turbine generator sub-base	Base	Base	Base	Base	Base	Base
Condenser Pit-Size Increment	1,400	1,400	2,100	2,800	3,500	5,600
TOTAL ITEMS 1 - 11	14,332,700	14,151,800	14,035,350	13,975,700	13,903,550	13,932,600
TOTAL CONSTANT COST						
TOTAL TURBINE PLANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
	19,524,200	19,343,300	19,226,850	19,167,200	19,095,050	19,124,100
Piping in Containment Vessel	269,600	256,400	291,300	291,300	291,300	240, 400
GRAND TOTAL	19,793,800	19,599,700	19,518,150	19,458,500	19,386,350	19,364,500

1000 PSIA, 745 F THROTTLE STEAM (200 F SUPERHEAT) 300 MWe INDIRECT CYCLE TURBING PLANT

HEATED ADDAMCEMENT	6		4	3	2	i
HEATER ARRANGEMENT 1. Turbine Generator And Accessories						
a. Turbine generator unit	8,440,000	8,440,000	8,440,000	8,440,000	8,440,000	8,440,000
b. Turbine generator erection	390,000	390,000	390,000 ———— Cons	390,000	390,000	390,000
c. Reserve exciter d. Turbine foundation	167,000	167,000	167,000	157,000	167,000	167,000
2. Condensers	•			Ì		
a. Shells and accessories) 800,000	800,000	813,500	840,500	881,000	935,000
b. Dry vacuum pumps)	450.000	/ ET E00	472,500	495,000	525,000
c. Tubes d. Steam jet air equipment	450,000 19,250	450,000 19,250	457,500 19,250	17,500	17,500	31,500
e. Erection	136,000	136,000	138,000	140,000	146,000	154,000
f. Deseration - hot well of cond.	None	20,000	20,000	10,000	10,000	42,100 10,000
g. L-P htrs. in exhaust stack	20,000	20,000	20,000	20,000	10,000	10,000
3. Circulating Water System A - Structures a. Crib house a'. Substructure b'. Superstructure c'. Steel d'. Miscellaneous b Dredging c. Intake flume or forebay d. Seal well e. Discharge flume))) 482,000))))	485,000	489,000	499,000	512,000	532,000
f. Outfall B - Crib House Equipment (erected) a. Traveling screens b. Screen wash pumps c. Screen wash piping d. Chlorination equipment)) 131,000)	132,000	134,000	138,000	144,000	152,000
e. Chiorine handling C - Circulating Water Piping) 484,000	486,000	489,000	496,000	504,000	519,000
D - Circulating Water Pumps	100.000	102 000	105 000	202,000	210,000	225,000
a. Pumps	190,000 145,500	192,000 146,000	195,000 148,000	51,500	155,500	162,500
c. Erection	18,050	18,650	18,850	19,250	19,800	20,600
4. Feed Water Heaters						
A - L-P Closed Heaters	139,500	93,000	93,500	47,000	49,000	94 500
B - H-P Closed Heaters	190,000 112,000	175,500 108,700	83,200 106,500	77,500 105,000	104,000	86,500
C - <u>Deacrating Heater</u> D - <u>Insulation</u>	112,000	100,700	100,500	102,000	,	
a. Closed heaters	5,600	4,000	1,800	1,300	- 7,600	•
d. Deaerating E - <u>Structural Work</u>	8,200	8,000	7,800	7,700	7,000	
a. For closed heaters	17,500	14,000	7,000	7,000		-
b. For deserating heater	23,600	22, 9 00	22,900	21,900	21,600	-
5. Boiler Feed Pumps		107 500	1061000	134,500	133,500	132,500
 a. Pumps and base plate b. Fluid drive 	140,500 96,000	137,500 96,000	136:000 96.000	96,000	96,000	96,000
c. Motors	199,000	186,000	174,500	167,500	162,000	161,500
d. Erection	16,700	15,800	15,400	14,900 3,800	14,700 3,750	14,300 3,650
e. Foundations for pumps	4,300	4,050	3,950	3,000	3,730	3,030
6. Condensate Pumps	42,000	32,100	32,600	25,000	26,200	
a. Pumps b. Motors	30,800	18,100	18,400	12,200	12,700	-
c. Erection	5,200	5,000	5,000	4,900	5,000	-
7. Piping And Insulation				i		
 a. Extraction Steam b. Heater vents and drains)) 192,600	161,800	138,200	127,100	81,000	43,200
 c. Boiler feed piping d. Condensate piping 	135,000	135,000	102,600	87,700	64,100	105,000
a'. From condensate pumps through L-P heaters b'. For D.C. heater and) 72,600	61,500	61,500	61,700	61,700	-
B.F. pump suction e. Main steam	16,100	15,000	15,000	15,000	15,000	15,000
8. Demineralizing Equipment And Condensate Storage Tanks	176,000	166,000	161,000	155,000	153,000	150,000
9. Electrical	121,600	115,700	115,700	114,900	111,300	90,300
O. Turbine Room Building				İ		
a. Building	Base	Base	Base	Base	Base	Base
b, Turbine generator sub-base	Base	Base	Base	Base	Base 2 100	Base 3,500
11. Condenser Pit-Size Increment	Base	Base	400	1,100	2,100	-
TOTAL ITEMS 1 - 11	13,617,600	13,457,550	13,318,050	13,271,950	13,216,050	13,207,150
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500 18,407,550	5,191,500 18,398,650
TOTAL TURBINE PLANT COST	18,809,100	18,649,050 277,400	18,509,550 312,300	18,463,450 312,300	312,300	261,400
12. Piping In Containment Vessel GRAND TOTAL	294,500	18,926,450	18,841,850	18,775,750	18,719,850	18,550,050
GIGHT TOTAL	19,103,600	10,720,430	10,041,030	10,773,730	10,719,030	,,

SUMMARY OF COST DATA 1000 PSIA, 845 F THROTTLE STEAM (300 F SUPERHEAT) 300 MWW INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	6	5	4	3	2	1
1. Turbine Generator and Accessories						
a. Turbine generator unit	8,440,000	8,440,000	8,440,000	8,440,000	8,440,000	8,440,000
b. Turbine generator erection	390,000	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter d. Turbine foundation 2, Condensers	167,000	167,000	167,000	nstant 167,000	167,000	
				1	107,000	107,000
a. Shells and accessories	746,000	759,500	773,000	786,500	827,000	881,000
b. Dry vacuum pumps c. Tubes	(20,000	407 600				
d. Steam jet air equipment	420,000 19,250	427,500 19,250	435,000			495,000
e. Erection	128,000	130,000	19,250 132,000			31,500
f. Deseration - hot well of cond.	None	150,000	132,000	134,000	139,000	146,000
g. L-P htrs. in exhaust stack	20,000	20,000	20,000	10,000	10,000	39,700 10,000
. Circulating Water System		,	,	20,000	20,000	10,000
A - Structures						
a. Crib house)					
a'. Substructure)					
b' Superstructure)					
c'. Steel)			İ		
d'. Miscellaneous b. Dredging) 465,000	466,000	472,000	480,000	490,000	512,000
c. Intake flume or forebay	{			1		
d. Seal well	(
e. Discharge flume	í			1		
f. Outfall	5					
B - Crib House Equipment (erected)				1		
a. Traveling screens)					
b. Screen wash pumps)			i		
c. Screen wash piping) 124,000	125,000	127,000	130,000	135,000	144,000
 d. Chlorination equipment e. Chlorine handling)			*		
C - Circulating Water Piping	472,000	472 000	477 000	1 (00 000	100 004	
D - Circulating Water Pumps	4/2,000	473,000	477,000	482,000	490,000	504,000
a. Pumps	180,000	181,000	184,000	189,000	196,000	210,000
b. Motors	140,000	140,500	142,500	144,500	148,500	155,500
c. Erection	17,850	17,900	18,150	18,450	18,900	19,800
. Feed Water Heaters				'	•	
A - L-P Closed Heaters	136,000	89,500	90,000	45,500	46,500	
B - H-P Closed Heaters	182,500	169,500	80,500	75,800	-	81,800
C - Desersting Heater	107,000	104,400	102,000	101,000	.00,000	
D - Insulation						
a. Closed heaters	5,300	3,700	1,700	1,300	-	-
b. Descrating E - Structural Work	7,900	7,600	7,500	7,500	7,400	-
a. For closed heaters	17,500	14 000	7 000	7 000		
b. For descrating heater	22,500	14,000 21,800	7,000 21,400	7,000	20,800	-
Boiler Feed Pumps	22,500	44,000	21,400	21,000	20,000	-
a. Pumps and base plate	137,500	135,000	122 500	222 500	112 000	101 000
b. Fluid drive	96,000	96,000	133,500 96,000	132,500	132,000	131,000
c. Motors	181,000	170,000	160,500	96,000 154,500	96,000 150,000	96,000 150,500
d. Erection	15,800	15,100	14,700	14,300	14,100	13,800
e. Foundation for pumps	4,050	3,850	3,750	3,600	3,550	3,500
Condensate Pumps				į ·	•	
a. Pumps	38,700	29,700	30,200	23,200	24,400	-
b. Motors	28,500	16,900	17,200	11,500	11,900	-
c. Erection	5,000	4,700	4,800	4,600	4,800	-
Piping and Insulation				i i		
a. Extraction steam		161,300	135,400	122,500	80,500	43,200
b. Heater vents and drains				[•
c. Boiler feed piping	129,900	129,900	102,600	87,700	64,100	105,000
d. Condensate piping				1		
a'. From condensate pumps) through L-P heaters)	72,600	63 500	41 500	67 000		
b'. For D.C. heater and	72,600	61,500	61,500	57,200	57,200	-
B.F. pump suction				1		
e. Main ateam	44,300	44,300	41,200	41,200	41,200	41,200
Demineralizing Equipment and	•		,	,	,	,
Condensate Storage Tanks	166,000	158,000	154,000	149,000	147,000	144,000
Electrical			-	1	-	
	112,400	110,800	112,100	111,300	111,300	90,300
Turbine Room Building		_	_	1_		
a. Building	Base	Base	Base	Base	Base	Base
b. Turbine generator sub-base	Base	Base	Base	Base	Base	Base
Condenser Pit-Size Increment	Base	Base	Bese	Base	700	2,100
TOTAL ITEMS 1 - 11	13,426,950	13,304,200	13,174,450	13,099,650	13,047,350	13,047,900
TOTAL CONSTANT COST	5,191,500					
		5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	18,618,450	18,495,700	18,365,950	18,291,150	18,238,850	18,239,400
Piping in Containment Vessel	405,700	368,200	400,000	400,000	400,000	349,100
GRAND TOTAL	19,024,150	18,863,900	18,765,950	18,691,150	18,638,850	18,588,500

TABLE 12.3 (Continued)

SUMMARY OF COST DATA
1000 PSIA, 945 F THROTTLE STEAM
(400 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT		6	5	4	3	2	1
a. Turbine Generator and Accessories a. Turbine generator unit	7	890,000			7,890,000	8,519,700	8,519,700 390,000
b. Turbine generator erection		390,000	390,000	390,000	\$90,000	390,000	390,000
c. Reserve exciter		167.000	167,000	Consta 167,000	167,000	167,000	167,060
d. Turbine foundation		167,000	167,000	107,000	:		•
. Condensers		601 000	705 500	719,000	746,000	773,000	827,000
a. Shells and accessories)	692,000	705,500	717,000	140,000	,	
b. Dry vacuum pumps c. Tubes	,	390,000	397,500	405,000	420,000	435,000	465,000
d. Steam jet air equipment		19,250	19,250	19,250	17,500	17,500	17,500
e. Erection		120,000	122,000	124,000	128,000	132,000	139,000 37,200
f Descration - hot well of cond		None	20,000	20,000	10,000	10,000	10,000
g. L-P htrs. in exhaust stack		20,000	20,000	20,000	10,000	20,000	
. Circulating Water System							
A - Structures							
a. Crib house	ζ.						
a'. Substructure b'. Superstructure	Ś	447,000	450,000	455,000	461,000	471,000	490,000
c'. Steel	5		•				
d' Miscellaneous)						
b. Dredging)				!		
c. Intake flume or forebay	- {						
d. Seal well e. Discharge flume	- (i		
f. Outfall	Ś						
B - Crib House Equipment (erected)							
a. Traveling screens)		119 000	120 000	123,000	127,000	135,000
b. Screen wash pumps	-	117,000	118,000	120,000	1.5,000	,	,
c. Screen wash piping	{				į.		
 d. Chlorination equipment e. Chlorine handling 	Ś						(00.000
C - Circulating Water Piping	•	460,000	461,000	465,000	469,000	476,000	490,000
D - Circulating Water Pumps					177.000	183,000	196,000
a. Pumps		163,000	165,000	173,000 136,500	177,000	142,000	148,000
b. Motors		134,000 17,100	135,000 17,200	17,400	17,700	18,100	18,900
c, Erection		17,100	17,400	,			
. Feed Water Resters		122 000	87,000	85,000	44,000	45,000	-
A - L-P Closed Heaters		132,000 176,500	163,700	78,500	74,000		80,000
B - H-P Closed Heaters		103,000	101,000	99,000	98,000	97,000	-
C - <u>Deaerating Heater</u> D - <u>Insulation</u>		102,000					
a. Closed heaters		5,000	3,500	1,650	1,200	7 200	-
b. Deserating		7,600	7,500	7,300	7,300	7,200	
B - Structural Work			16 000	7,000	7,000		-
a. For closed heaters		17,500 21,500	14,000 21,000	20,500	20,400	20,200	-
b. For deserating heater		11,500	,		1		
5. Boiler Feed Pumps		126 000	133,000	132,000	130,500	130,000	129,500
a. Pumps and base plate		135,000 96,000	96,000	96,000	96,000	96,000	96,000
 b. Fluid drive c. Motors 		166,500	157,000	148,500	144,500	139,500	140,500
d. Brection		15,100	14,400	14,100	13,800	13,700	13,400 3,350
e. Foundations for pumps		3,850	3,650	3,550	3,450	3,450	3,330
6. Condensate Pumps					÷	4	
a. Pumps		35,800	27,800	28,000	21,800	22,600	-
b. Motors		26,600	16,000	16,100	10,900	11,300 4,600	-
c. Erection		4,700	4,500	4,600	4,400	4,000	
7. Piping and Insulation							
a. Extraction steam)			125 400	122 500	80,500	43,200
b. Heater vents and drains)	187,400	161,300 129,900	135,400 102,600	122,500 87,700	64,100	105,000
c. Boiler feed piping)	129,900	129,500	102,000	0,,,,,	• . ,	•
 d. Condensate piping a'. From condensate pumps)				1		
thru L-P heaters	Ś	68,000	57,000	57,000	55,600	55,600	-
b'. For D.C. heater and	j						
B.F. pump suction)				52 400	57,400	50,80
e. Main steam		57,400	57,400	57,400	57,400	37,400	50,000
8. Demineralizing Equipment and					i	24.0 000	120 000
Condensate Storage Tanks		158,000	151,000	148,000	144,000	142,000	139,000
9. Electrical		108,400	106,800	106,800	102,900	107,800	86,800
		•	•		ì		
O. Turbine Room Building		-6,400	-6,400	-6,400	-6,400	-	-
a. Building b. Turbine generator sub-base		-1,000	-1,000	-1,000	-1,000	-	-
		-		<u>-</u>	i -	-	76
					12 050 250	12,959,250	12,938,5
1. Condenser Pit-Size Increment		12,674,700	12,563,500	12,442,750	12,959,250		
TOTAL ITEMS 1 - 11							
		5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	
TOTAL ITEMS 1 - 11			17,755,000	17,634,250	17,586,150	18,150,750	18, 130, 0
TOTAL ITEMS 1 - 11 TOTAL CONSTANT COST		5,191,500					5, 191, 50 18, 130, 05 391, 70 18, 521, 75

SUMMARY OF COST DATA 800 PSIA, 518 F THROTTLE STEAM (SATURATED STEAM) 300 MWe INDIRECT CYCLE TURBINE PLANT

THROTTLE FLOW, #/HR.		4,267,000	3,979,000	3,712,000	3,498,000	3,352,000	3,372,000
HEATER ARRANGEMENT		6	5	4	3	2	1
. Turbine Generator and Accessories			····		······································		······································
a. Turbine generator unit b. Turbine generator erection		10,445,000 419,000	10,445,000 419,000	10,445,000 419,000	10,445,000 419,000 stant	10,445,000 419,000	10,445,000 419,000
 c. Reserve exciter d. Turbine foundation 		190,000	190,000	190,000	190,000	190,000	190,000
a. Shells and accessories b. Dry vacuum pumps)	948,500	962,000	975,500	1,016,000	1,056,500	1,140,000
c. Tubes	,	532,500	540,000	547,500	570,000	592,500	817,000
d. Steam jet air equipment e. Erection		19,250 156,000	17,500 158,000	17,500 160,000	17,500 166,000	17,500 172,000	28,000 174,500
f. Deseration - hotwell of cond. g. L-P htrs. in exhaust stacks		20,000	20,000	20,000	10,000	10,000	47,500 10,000
Circulating Water System							
A - Structures a. Crib house	>						
a'. Substructure b'. Superstructure)						
c', Steel	5						*** ***
d'. Miscellaneous b. Dredging	}	540,000	544,000	549,000	561,000	577,000	560,000
c. Intaka flume	į						
d. Seal well e. Discharge flume	3						
f. Outfall B - Crib House Equipment (erected))			į			
a. Traveling screens)						
b. Screen wash pumps c. Screen wash piping)	155,000	156,000	158,000	163,000	169,000	163,000
d. Chlorination equipment e. Chlorine handling C - Circulating Water Piping	5	522,000	524,000	528,000	537,000	548,000	536,000
D - Circulating Water Pumps				i			•
a. Pumps b. Motors		227,050 164,160	229,425 165,305	233,225 167,505	240,825 171,200	251,275 176,745	235,290 181,585
c. Erection		20,840	20,990	21,230	21,720	22,370	21,680
Feed Water Heaters A - L-P closed heaters		152,000	100,000	100,000	47,500	49,000	_
B - H-P closed heaters		188,500	176,500	84,500	64,000	-	78,500
C - Deserating heater D - Insulation		125,000	121,000	118,000	114,000	113,000	-
a. Closed heaters		6,300 9,200	4,600 8,900	2,200 8,700	1,100 8,400	8,300	-
b. Deaerating E - Structural Work						-,	
a. For closed heaters b. For deserating heater		17,500 27,500	14,000 26,000	7,000 25,000	7,000 24,500	24,000	-
Boiler Feed Pumps				İ			
a. Pumps and base plate b. Fluid drive		135,000 96,000	129,000 96,000	126,000 96,000	123,000 71,100	121,500 71,100	120,000 71,100
c. Motors		169,670	163,060	150,050	141,010	133,730	137,480
d, Erection e. Foundations for pumps		17,100 3,950	16,200 4,650	15,600 4,350	15,000 4,200	14,700 4,200	14,100 4,050
Condensate Pumps		-,	,	,	,	•	•
a. Pumps		61,500 32,710	39,750 19,480	40,050 19,750	29,550 14,080	30,900 14,620	-
b, Motors c. Erection		6,200	5,800	5,850	5,550	5,750	-
Piping and Insulation a. Extraction steam	>	213,100	186,500	153,700	127,800	104,600	49,300
b. Heater vents and drains)			72,000	72,000	49,300	87,500
c. Boiler feed piping d. Condensate piping)	116,900	116,900	,2,00 	72,000	45,500	0,,55
 a'. From condensate pumps through L-P heaters)	82,400	75,500	75,500	68,800	68,800	
b1. For D-C heater and)	,				,	
B-F pump suction e, Main steam	>	23,600	23,000	22,500	21,700	21,500	21,100
Demineralizing Equipment and Condensate Storage Tanks		191,000	183,000	175,500	169,000	165,000	165,500
Electrical		117,900	119,300	112,300	112,300	113,800	93,400
Turbine Room Building a. Building		70,000	70,000	70,000	70,000	70,000	70,000
b. Turbine generator sub-base		11,000	11,000	11,000	11,000	11,000	11,000
Condenser Pit-Size Increment		3,850	4,200	4,550	5,600	6,650	12,200
TOTAL ITEMS 1 - 11		16,236,780	16,101,860		15,856,435	15,848,340	15,903,785
TOTAL CONSTANT COST		5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST		21,428,280	21,293,360	21,123,060	21,047,935	21,039,840	21,095,28
Piping in Containment Vessel		304,000	274,000	258,000	250,000	250,000	244,000
GRAND TOTAL		21,732,280	21,567,360	21,381,060	21,297,935	21,289,840	21,339,285

TABLE 12.3 (Continued)

SUMMARY OF COST DATA

800 PSIA, 618 F THROTTLE STRAM
(100 F SUPERREAT)
300 MMe INDIRECT CYCLE TURBINE PLANT

_	HEATER ARRANGEMENT	- 6	5	4	3	2	1
1.	Turbine Generator and Accessories						
	a. Turbine generator unit	8,820,000	8,820,000	8,820,000	8,820,		
	 b. Turbine generator erection c. Reserve exciter 	390,000	390,000	390,000 Cons	β90,	000 419,00	417,000
	d. Turbine foundation	167,000	167,000	167,000	167,	000 190,00	0 190,060
2.	Condensers				-		
	a. Shells and accessories	894,500	894,500	908,000	948,	500 975,50	0 1,056,500
)	600 E00	E10 000	532,	500 547,50	0 592,500
	 c. Tubes d. Steam jet air equipment 	502,500 19,250	502,500 17,500	510,000 17,500		500 17,50	
	e. Brection	148,000	148,000	150,000	156		0 172,000
	f. Deseration - hot well of cond.	None					
	g. L-P htrs. in exhaust stack	20,000	20,000	20,000	10,	000 10,00	0 10,000
3.	Circulating Water System A - Structures a. Crib house a'. Substructure	}					
	b'. Superstructure c'. Steel d'. Miscellaneous b. Dredging c. Intake flume or forebay) 517,000))	519,000	524,000	535,	000 547,00	0 575,000
	d. Seal well e. Discharge flume f. Outfall B - Crib House Equipment (erected) a. Traveling screens)))) 146;000	147,000	149,000	153,	000 158,00	0 170,000
	e. Chlorine handling))))				200 500 00	0 548 000
	C - Circulating Water Piping D - Circulating Water Pumps	508,000	510,000	513,000	521,	000 529,00	0 549,000
	a. Pumps	213,000	215,000	218,000	225,	000 233,00	0 251,000
	b. Motors	157,000	158,000	159,500	163,	000 167,50	
	c. Erection	20,000	20,100	20,300	20,	700 21,30	0 22,400
4.	Feed Water Heaters	1/1 500	01 000	00.000	,,	000 47 00	۸
	A - L-P Closed Heaters B - H-P Closed Heaters	144,500 175,000	94,000 175,500	95,000 80,000		000 47,00 800 -	75,500
	C - Descrating Heater	117,500	114,000	112,000		000 109,00	
	D - Insulation						
	a. Closed heaters	5,700	4,100	2,000		100 -	-
	b. Deaerating E - Structural Work	8,600	8,300	8,200	۰,	100 8,00	u -
	a. For closed heaters	17,500	14,000	7,000	7.	000 -	-
	 For deserating heater 	25,100	24,200	23,500		100 22,90	0 -
5.	Boiler Feed Pumps						
	a. Pumps and base plate	100,500	99,000	98,500		000 97,50	
	b. Fluid drive c. Motors	96,000 185,000	96,000 176,500	96,000 166,000		000 96,00 000 153,50	
	d. Erection	15,900	15,000	14,600		200 14,00	
	e. Foundations for pumps	4,600	4,300	4,150		000 3,95	
6.	Condensate Pumps				į		
	a. Pumps	55,100	35,100	36,600		800 29,00	0 -
	b. Motors	29,700	17,900	18,200		400 13,90	
	c. Erection	5,700	5,400	5,500	, خ	300 5,50	0 -
7.	Piping and Insulation a. Extraction steam) 213,100	186,500	153,700	127,	800 104,60	0 49,300
	b. Heater vents and drains)					
	c. Boiler feed piping	126,000	126,000	78,200	78,	200 49,30	0 96,500
	d. Condensate piping a'. From condensate pumps	{					
	thru L-P heaters	72,600	61,500	61,500	61,	700 61,70	0 -
	b'. For D.C. heater and)		•	1	•	
	B.F. pump suction)	16 700	1/ 100	,,	100 14 14	0 16 100
	e. Main steam	15,700	15,700	14,100	14,	100 14,10	0 14,100
8.	Demineralizing Equipment and	187 000	175 000	171 000	120	000 163 00	0 150 000
0	Condensate Storage Tanks	187,000	175,000	171,000		000 163,00	
	Electrical	117,300	115,700	112,100	111,	300 116,50	0 95,100
10.	Turbine Room Building A. Building		_	_	İ	70,00	0 70,000
	b. Turbine generator sub-base	-	-	-	1.5	11,00	
11		2,500	2,500	2,800	2	900 4,60	
	Condenser Pit-Size Increment				1		-
	TOTAL ITEMS 1 - 11	14,242,850	14,094,800	13,926,950	13,897,		
	TOTAL CONSTANT COST	5;191,500	5,191,500	5,191,500	5,191,		
	TOTAL TURBINE PLANT COST	19,434,350	19,286,300	19,118,450	19,088,		
12.	Piping in Containment Vessel	342,600	342,600	230,900	230	900 230,90	0 229,100
	GRAND TOTAL	19,776,950	19,628,900	19,349,350	19,319,	400 20,656,05	0 20,747,050
		,,,,	., .,,			, . ,	

SUMMARY OF COST DATA
800 PSIA, 718 F THROTTLE STEAM
(200 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	6	5	. 4	3	2	1
. Turbine Generator and Accessories						
a. Turbine generator unit	8,820,000	8,820,000	8,820,000	8,820,000	8,820,000	9,725,000
 Turbine generator eraction 	390,000	390,000			390,000	419,000
c. Reserve exciter				nst ø nt ———		\longrightarrow
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	190,000
. Condensers				1		
a. Shells and accessories) 840,500	840,500	854,000	881,000	908,000	975,500
b. Dry vacuum pumps)					
c. Tubes	472,500	472,500	480,000	495,000	510,000	547,500
 d. Steam jet sir equipment e. Erection 	19,250 140,000	17,500 140,000	17,500	17,500	17,500	28,000
f. Deseration - hotwell of cond.	None	140,000	142,000	146,000	150,000	160,000 43,900
g. L-P htrs. in exhaust stack	20,000	20,000	20,000	10,000	- 10,000	10,000
. Circulating Water System	,	,	,	,	,	20,000
A - Structures						
a. Crib house)			- 1		
a'. Substructure)					
b'. Superstructure)					
c'. Steel)	100 000				
d'. Miscellaneous b. Dredging	486,000	498,000	503,000	512,000	523,000	547,000
c. Intake flume or forebay	,					
d. Seal well	5			1		
e. Discherge flume)			-		
f. Outfall)]		
B - Crib House Equipment (erected)						
a. Traveling screens)					
 b. Screen wash pumps c. Screen wash piping) 137,000	120 000	240.000	144 000	1/0.000	150 000
d. Chlorination equipment) 137,000	138,000	140,000	144,000	148,000	158,000
e. Chlorine handling	í					
C - Circulating Water Piping	494,000	495,000	498,000	504,000	512,000	529,000
D - Circulating Water Pumps	•	•	•		•	•
a, Pumpa	200,000	201,000	204,000	210,000	217,000	233,000
b. Motors	150,500	151,000	152,500	155,500	159,000	167,500
c. Erection	19,100	19,200	19,400	19,800	20,200	21,200
Feed Water Heaters						
A - L-P Closed Heaters	135,000	90,000	91,000	44,000	45,000	- -
B - H-P Closed Heaters	167,500	158,000	76,500	61,000	105 000	73,000
C - Descrating Heater D - Insulation	112,000	109,000	107,000	106,000	105,000	•
a. Closed heaters	5,300	3,800	1,900	1,000		
b. Descrating	8,200	8,000	7,900	7,800	7,700	_
E - Structural Work	•			.,		
a. For closed heaters	17,500	14,000	7,000	7,000	-	_
 b. For deserating heater 	23,700	23,000	22,500	22,100	21,800	-
Boiler Feed Pumps						
 Pumps and base place 	99,000	98,000	97,500	97,000	96,500	96,000
b. Fluid drive	96,000	96,000	96,000	96,000	96,000	96,000
c. Motors	166,500	160,000	151,000	145,500	141,000	142,500
d. Erection e. Foundations for pumps	14,900	14,200	13,900	13,500	13,400	13,100
	4,250	4,050	3,950	3,800	3,800	3,700
Condensate Pumps a. Pumps	50 400	22 000	33 600	25 600	26 800	
b. Motors	50,400 27,300	33,000 16,600	33,600 16,900	25,600 12,500	26,800 12,000	
c. Erection	5,300	5,100	5,200	5,000	5,200	-
Piping and Insulation	-,	-,	-,	4	•,	
a. Extraction steam) 205,700	176,800	147,400	125,700	89,200	49,300
b. Heater vents and drains)	2,0,000	247,400	123,.00	03,200	47,500
c. Boiler feed piping	126,000	98,000	78,200	78,200	49,300	96,500
d. Condensate piping)			i		
a'. From condensate pumps)			i		
through L-P heaters	72,600	61,500	61,500	61,700	61,700	-
b'. For D.C. heater and B.F. pump suction)).			1		
e. Main steam	15,700	15,700	14,100	14,100	14,100	14,100
	20,700	25,740	14,100	17,200	14,100	1-7,100
Condensate Storage Tanks	125 OOD	166 000	162 000	157 000	155 000	152 000
Condensate Storage Tanks	175,000	166,000	162,000	157,000	155,000	152,000
Electrical	113,300	111,700	112,100	111,300	107,800	91,600
Turbine Room Building				İ		2
a. Building	-	-	-	-	-	70,000
b. Turbine generator sub-base	-	-	-	-	-	11,000
Condenser Pit-Size Increment	1,100	1,100	1,400	2,100	2,800	4,600
TOTAL ITEMS 1 - 11	14,008,100	13,833,250	13,619,650	13,669,700	13,605,800	14,668,000
TOTAL CONSTANT COST						
	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	19,199,600	19,023,750	18,811,150	18,861,200	18,797,300	19,859,500
	342,600	294,000	230,900	230,900	230,900	229,100
Piping in Containment Vessel	342,000					
Piping in Conteinment Vessel GRAND TOTAL	19,542,200	2,4,000	,	,,	,	20,088,600

800 PSIA, 818 F THROTTLE STEAM (300 F SUPERREAT) 300 MWe INDIRECT CYCLE TURBINE PLANT

TO LOTED LOD AND CAPACITA		5	4	3	2	1
HEATER ARRANGEMENT	6		 -	- 	····	······
1. Turbine Generator and Accessories a. Turbine generator unit	8,420,000	8,420,000	8,420,000	8,420,000	8,420,000	8,420,000
b. Turbine generator dust b. Turbine generator erection	390,000	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter		330,000	Cons		,	\longrightarrow
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000
2. Condensers						
a. Shells and accessories	786,500	786,500	800,000	827,000	854,000	908,000
b. Dry vacuum pumps)					
c. Tubes	442,500	442,500	450,000	465,000	480,000	510,000
d. Steam jet air equipment	19,250	17,500	17,500	17,500	17,500 142,000	28,000 150,000
 e. Erection f. Deseration - hot well of cond. 	134,000 None	134,000	136,000	139,000	142,000	40,900
g, L-P htrs. in exhaust stack	20,000	20,000	20,000	10,000	10,000	10,000
-					•	·
3. Circulating Water System A - Structures						
a. Crib house)					
a'. Substructure)					
b'. Superstructure) 477,000	480,000	482,000	492,000	501,000	524,000
c'. Steel)					
d'. Miscellaneous	}			i		
b. Dredging	{			1		
 c. Intake flume or forebay d. Seal well 	`			1		
e. Discharge flume	Ś			İ		
f. Outfall)			i		
B - Crib House Equipment (erected)				1		
a. Traveling screens)	120 000	122 000	136 000	139,000	149,000
b. Screen wash pumps) 129,000	130,000	132,000	136,000	139,000	143,000
 c. Screen wash piping d. Chlorination equipment 	ί.					
e. Chlorine handling	Ś					
C - Circulating Water Piping	480,000	482,000	484,000	491,000	497,000	513,000
D - Circulating Water Pumps						
a. Pumps	187,000	189,000	191,000	197,000	203,000	218,000
b. Motors	144,000 18,300	144,500 18,400	145,500 18,600	149,000	152,000 19,300	159,500 20,300
c. Erection	10,300	10,400	10,000	19,000	19,300	20,500
. Feed Water Heaters			07.600	40.000	42 500	
A - L-P Closed Heaters	130,000	87,000	87,500	43,000	43,500	71,000
B - H-P Closed Heaters	161,000	152,500 105,000	74,000 103,000	59,500 102,000	101,000	71,000
C - <u>Deserating Heater</u> D - <u>Insulation</u>	107,500	103,000	103,000	102,000	101,000	
a. Closed heaters	5,000	3,600	1,800	1,000	_	
b. Deserating	7,900	7,700	7,600	7,500	7,500	-
· E - Structural Work						
a. For closed heaters	17,500	14,000	7,000	7,000	41 100	-
 b. For deserating heater 	22,500	22,000	21,500	21,200	21,100	-
5. Boiler Feed Pumps					04 000	05 500
a. Pumps and base plate	98,000	97,000	96,500	96,000	96,000 71,100	95,500 71,100
b. Fluid drive	96,000	96,000 146,500	, 71,100 139,000	71,100	131,000	133,500
c. Motors d. Erection	152,000 14,200	13,500	13,300	13,000	12,900	12,600
e. Foundations for pumps	4,050	3,850	3,750	3,650	3,600	3,550
		•	•	1		
6. Condensate Pumps a. Pumps	46,300	30,700	31,000	24,900	25,800	_
b. Motors	25,300	15,600	15,800	11,800	12,200	-
c. Erection	5,000	4,800	4,900	4,800	4,900	-
7. Piping and Insulation						
a. Extraction steam) 205,700	173,400	139.000	116,400	88,800	49,300
b. Heater vents and drains)					
c. Boiler feed piping	98,000	98,000	78,200	78,200	49,300	96,500
d. Condensate piping	į			ľ		
a'. From condensate pumps) 72 400	61 500	61,500	57,200	57,200	_
thru L-P heaters b'. For D.C. heater and) 72,600	61,500	01,500	37,200	37,200	
B.F. pump suction	3					
e. Main steam	44,500	44,100	44,100	41,100	41,100	41,100
3. Demineralizing Equipment and	-					
Condensate Storage Tanks	166,000	157,000	154,000	150,000	149,000	146,000
	113,300	111,700	108,200	107,800	87,800	86,800
9. Electrical	113,300	111,700	100,200	107,000	57,000	00,000
O. Turbine Room Building				1 _	_	_
a, Building b. Turbine generator sub-base	:		:	1 :	-	-
-	•	-	-			2 222
l. Condenser Pit-Size Increment	•	-	-	700	1,400	2,800
TOTAL ITEMS 1 - 11	13,406,900	13,266,850	13,116,350	13,071,350	12,997,000	13,017,450
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
				1		
TOTAL TURBINE PLANT COST	18,598,400	18,458,350	18,307,850	18,262,850	18,188,500	18,208,950
 Piping in Containment Vessel 	303,500	294,000	292,300	283,200	283,200	281,400
GRAND TOTAL	18,901,900	18,752,350	18,600,150	18,546,050	18,471,700	18,490,350
	10,701,700	10,752,000	.0,000,200	-0,540,050	10,471,00	,.,,,,,,,
				1		

SUMMARY OF COST DATA
800 PSIA, 1000 F THROTTLE STEAM
(500 F SUPERHEAT)
300 MMe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	, 6	5	4	3	2	<u> </u>
Turbine Generator and Accessories						· · · · · · · · · · · · · · · · · · ·
a. Turbine generator unit	8,110,000	8,110,000	8,110,000	8,740,000	8,740,000	8,740,000
b. Turbine generator erection	390,000	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000
Condensers	•		,		•	
a. Shells and accessories b. Dry vacuum pumps) 692,000	705,500	705,500	7\$2,500	746,000	800,000
c. Tubes	390,000	397,500	397,500	4 2,500	420,000	450,000
d. Steam jet air equipment	19,250	17,500	17,500	7,500	17,500	28,000
e. Brection	120,000	122,000	122,000	126,000	128,000	136,000
f. Descration - hot well of cond.	None					36,000
g. L-P htrs. in exhaust stacks	20,000	20,000	20,000	10,000	10,000	10,000
Circulating Water System A - Structures a. Crib house)					
a'. Substructure b'. Superstructure)					
e'. Steel	í					
d'. Miscellaneous) 443,000	447.,000	447,000	4\$6,000	463,000	482,000
b. Dredging	?					
 c. Intake flume or forebay d. Seal well 	₹					
e. Discharge flume	ζ					
f, Outfall	5			į		
B - Crib House Equipment (erected)						
a. Traveling screens	}					
b. Screen wash pumps c. Screen wash piping) 115,000	117,000	117,000	121,000	-124,000	132,000
d. Chlorination equipment)	,,	227,000	161,500	124,000	132,000
e. Chlorine handling)					
C - Circulating Water Piping	456,000	459,000	460,000	465,000	470,000	484,000
D - Circulating Water Pumps a. Pumps	165 000	150 000	171 000	174 000	128 000	101 000
b. Motors	165,000 133,500	168,000 134,000	171,000 134,000	174,000 137,000	178,000 139,000	191,000 145,500
c. Erection	16,900	17,100	17,100	17,500	17,700	18,600
Feed Water Hesters	•	•	•		·	•
A - L-P Closed Heaters	121,500	82,000	82,500	40,500	41,000	-
B - H-P Closed Heaters	150,000	143,000	69,500	\$8,500	-	67,500
C - Deserating Heater	100,000	98,000	96,500	96,000	95,500	-
D ~ Insulation	4 500	2 200	1 400	050		
a. Closed heaters b. Deserating	4,500 7,400	3,200 7,300	1,600 7,200	950 7,100	7,100	
E - Structural Work	7,400	7,500	,,200	7,100	7,200	-
a. For closed heaters	17,500	14,000	7,000	7,000	-	-
 For deserating heater 	20,900	20,400	20,000	19,900	19,800	-
Boiler Feed Pumps						
a. Pumps and base plate	96,000	95,500	95,000	94,500	94,500	94,500
b. Fluid drive c. Motora	71,100	71,100	71,100	71,100	71,100	71,100
d. Erection	130,000 13,000	125,500 12,500	120,000 12,300	117,000 12,100	114,500 12,100	117,500 11,900
e. Foundations for pumps	3,650	3,500	3,450	3,350	3,350	3,300
Condensate Pumps	•	•		1-2	-,	
a. Pumps	40,000	26,600	27,000	20,900	21,800	-
b. Motors	22,100	13,800	14,000	10,600	11,000	-
c. Erection	4,600	4,400	4,400	4,400	4,500	-
Piping and Insulation a. Extraction steam) 197,900	167,700	131,300	116 400	77 800	
b. Heater vents and drains) 197,900	207,700	134,300	116,400	77,800	49,300
c. Boiler feed piping	98,000	98,000	78,200	78,200	49,300	96,500
d. Condensate piping)			i '	•	-
a'. From condensate pumps) 68,000	FF 100	55 100	1	45 560	
through L-P heaters b'. For D.C. heater and) 68,000	55,400	55,400	45,600	45,600	-
B.F. pump suction	ś					
e. Main steam	66,900	66,900	66,900	66,900	66,900	66,900
Demineralizing Equipment and						
Condensate Storage Tanks	151,000	145,000	142,000	139,000	138,000	136,000
Electrical	104,500	103,300	99,800	99,000	99,400	83,300
Furbine Room Building	-	•	•	-	•	•
	-	_	-	<u> </u>	-	-
a. Bullding	-	-	-	-	-	-
			-	-	-	-
. Turbine generator sub-base	-			1		
o. Turbine generator sub-base Condenser Pit-Size Increment	12,726,200	12 628 700	12 480 750	13.076 6.0	12.983.450	13.007.000
a. Building b. Turbine generator sub-base Condenser Pit-Size Increment FOTAL ITEMS 1 - 11 FOTAL CONSTANT COST	12,726,200	12,628,700	12,480,750	13,076,600	12,983,450	
o. Turbine generator sub-base Condenser Pit-Size Increment FOTAL ITEMS 1 - 11 FOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
b. Turbine generator sub-base Condenser Pit-Size Increment						5,191,500
b. Turbine generator sub-base Condenser Pit-Size Increment FOTAL ITEMS 1 - 11 FOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	13,007,900 5,191,500 18,199,400 413,600

SUMMARY OF COST DATA 600 PSIA, 486 F THROTTLE STEAM (SATURATED STEAM) 300 MNe INDIRECT CYCLE TURBINE PLANT

THROTTLE FLOW, #/HR.		4,245,000	3,982,000	1,743,000	3,561,000	3,480,000
HEATER ARRANGEMENT		5	4	3	2	1
Turbine Generator and Accessories						J
a. Turbine generator unit		10,275,000	10,275,000	10,275,000	10,275,000 419,000	10,275,000 419,000
b. Turbine generator erection c. Reserve exciter		419,000	419,000	419,000 onstant Facto		425,000
d. Turbine foundation		190,000	190,000	190,000	190,000	190,000
Condensers		1 01/ 000	1 0/2 000	056.000	1,092,000	1 166 000
a. Shells and accessories b. Dry vacuum pumps)	1,016,000	1,043,000	1,056,000	1,092,000	1,164,000
c. Tubes	,	570,000	585,000	756,800	782,600	834,200
d. Steam jet air equipment		15,750	15,750	14,000	14,000 168,500	21,000 177,500
e. Brection f. Deaeration - hot well of cond.		166,000	170,000	164,000	100,500	48,50
g. L-P heaters in exhaust stacks		20,000	20,000	10,000	10,000	10,00
Circulating Water System						
A - Structures a. Crib house)					
a'. Substructure	ś					
b', Superstructure)					
c'. Steel d'. Miscellaneous)	562,000	570,000	534,000	547,000	570,50
b. Dredging)			1		
c. Intake flume)					
d. Seal well e. Discharge flume	í			:		
f, Outfall)			:		
B - Crib House Equipment (Eracted) a. Traveling screens)					
b. Screen wash pumps)					1.00.00
c. Screen wash piping)	164,000	166,000	152,000	157,000	167,00
d. Chlorination equipment e. Chlorine handling)			į.		
C - Circulating Water Piping	,	538,000	543,000	517,000	527,000	543,50
D - Circulating Water Pumps a. Pumps		241,775	246,525	218,085	226,920	241,80
b. Motors		171,905	174,105	171,640	176,745	185,28
c. Erection		21,770	22,070	20,570	21,140	22,10
Feed Water Heaters		115 200	110 500	E7 E00	50 000	
A - L-P closed heaters B - H-P closed heaters		112,000 162,500	113,500 76,000	57,500 71,000	59,000	78,00
C - Descrating heater		124,000	121,000	118,000	116,000	· :
D - Insulation		4 800	2 200	1 700	_	_
a, Closed heaters b, Deaerating		4,800 9,200	2,300 8,900	1,700 8,700	8,500	-
E - Structural Work		•	•			
a, For closed heaters		14,000 27,000	7,000 26,000	7,000 25,000	24,500	:
b. For descrating heater Boiler Feed Pumps		27,000	20,000	25,000	,500	
a. Pumps and base plate		105,000	1,00,500	96,000	91,500	90,00
b. Fluid drive		71,100	71,100	71,100	71,100 111,680	71,10 114,11
c. Motors d. Erection		135,715 15,000	124,250 14,400	119,620 13,500	13,200	12,60
e. Foundations for pumps		4,950	4,800	4,500	4,350	4,20
Condensate Pumps						
a. Pumps b. Motors		42,000 23,530	42,750 24,070	31,500 14,890	32,550 15,430	:
c. Erection		6,050	6,100	5,800	6,000	-
Piping and Insulation				1		
a. Extraction steam)	161,300	132,700	119,000	72,300	34,50
b. Heater vents and drains c. Boiler feed piping)	104,400	96,800	66,500	40,600	84,30
d. Condensate piping		ŕ	ŕ	İ		
a'. From condensate pumps through)	75,500	75,500	68,800	68,800	_
L-P heaters b'. For D-C heater and B.F. pump	Ś	73,300	,,,,,,	00,000	00,000	
suction)			04 000	24 200	26.00
e. Main steam		28,400	27,600	26,800	26,000	26,0
Demineralizing Equipment and Condensate		190,500	183,000	176,000	171,000	169,0
Storage Tanks		114,000	111,000	109,300	110,400	90,7
Electrical Turbino Boom Ruilding		114,000	,		,	
Turbine Room Building a. Building		70,000	70,000	70,000	70,000	70,0
b. Turbine-generator sub-base		11,000	11,000	11,000	11,000	11,0
Condenser Pit Size Increment		5,600	6,300	9,800	10,700	12,9
TOTAL ITEMS 1 - 11		15,988,745	15,896,020	15,801,105	15,741,515	15,737,8
TOTAL CONSTANT COST		5,191,500	5,191,500	5,191,500	5,191,500	5,191,5
TOTAL CONSTANT COST						
TOTAL TURBINE PLANT COST		21,180,245	21,087,520	20,992,605	20,933,015	20,929,3
		21,180,245 288,000	21,087,520 254,000	20,992,605	20,933,015	20,929,3

SUMMARY OF COST DATA
600 PSIA, 586 F THROTTLE STEAM
(100 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

_	HEATER ARRANGEMENT	5	4	3	2	1
1.	Turbine Generator And Accessories					
	a. Turbine generator unit	8,090,000	8,090,000	8,090,000	10,035,000 419,000	10,035,000 419,000
	b. Turbine generator erection c. Reserve exciter	390,000	390,000	390,000 Constant	419,000	419,000
	d. Turbine foundation	390,000	390,000	390,000	190,000	190,000
2.	Condensers				THE CASE OF THE CA	
) 948,500	962,000	989,000	1,016,000	1,068,000
	b. Dry vacuum pumps)	#10 000	FFF 000	570.000	765 1000
	c. Tubes d. Steam jet air equipment	532,500 15,750	540,000 15,750	555,000 14,000	570,000 14,000	765,000 21,000
	e. Erection	156,000	158,000	162,000	166,000	164,500
	f. Deseration - hot well of cond.	None		10 000	10.000	48,000
_	g. L-P htrs. in exhaust stack	20,000	20,000	10,000	10,000	10,000
3.	Circulating Water System A - Structures					
	a. Crib house)				
	a'. Substructure)	£/1 000	CEA 200	E43 ANA	520 000
	b'. Superatructure c¹. Steel) 535,000	541,000	550,000	563,000	539,000
	d'. Miscellaneous	Ś				
	b. Dredging)				
	 c. Intake flume or forebay d. Seal well 	} `				
	e. Discharge flume	Ś				
	f. Outfall)			1	
	B - Crib House Equipment (eracted) a. Traveling screens) 153,000	156,000	159,000	165,000	155,000
	b. Screen wash pumps)	,			,
	c. Screen wash piping)				
	 d. Chlorination equipment e. Chlorine handling))			Ë	
	C - Circulating Water Piping	521,000	525,000	531,000	540,000	523,000
	D - Circulating Water Pumps	006 000	440, 440	225 000	242.000	224 000
	a. Pumps b. Motors	226,000 163,000	229,000 165,000	235,000 : 168,000	243,000 172,500	228,000 174,500
	c. Erection	20,700	21,000	21,300	21,900	20,900
4.	Feed Water Heaters					
	A - L-P Closed Heaters	110,000	106,000	54,300	55,700	
	B - H-P Closed Heaters	151,000	71,700	67,800	111 000	75,500
	C - Deserating Heater D - Insulation	118,000	115,000	112,500	111,000	-
	a. Closed heaters	4,400	2,100	1,550	-	-
	b. Deserating	8,600	8,400	8,300	8,100	•
	E - Structural Work a. For closed heaters	14,000	7,000	7,000	-	-
	b. For descrating heater	25,100	24,400	23,800	23,400	-
5.	Boiler Feed Pumps					07.000
	a. Pumps and base plate b. Fluid drive	97,500 96,000	94,500 96,000	91,000 71,100	89,500 71,100	87,000 71,100
	c. Motors	155,500	144,500	139,000	133,000	134,500
	d. Erection	13,700	13,200	12,600	12,400	11,900
	e. Foundations for pumps	4,550	4,350	4,150	4,100	3,950
6.	Condensate Pumps	38,200	38,600	29,100	30,000	_
	a. Pumps b. Motors	21,700	21,900	13,900	14,400	-
	c. Erection	5,600	5,700	5,500	5,600	-
7.	Piping and insulation	_				
)) 161,300	132,700	119,000	72,300	34,500
	c. Boiler feed piping) 161,300 115,000	86,500	86,500	45,300	91,900
	d. Condensate piping	-	•			
	a'. From condensate pumps through L-P heaters)				
	b'. For D.C. heater and	61,500	61,500	61,700	61,700	-
	B.F. pump suction)			44 500	22 500
	e. Main steam	23,500	23,500	23,500	23,500	23,500
8.	Demineralizing Equipment and	180,000	178,000	171,000	168,000	162,000
	Condensate Storage Tanks			İ		-
9.	<u>Electrical</u>	112,600	113,800	113,000	113,000	91,600
10.	Turbine Room Building					70.000
	a. Building b. Turbine generator sub-base	-		I i	70,000 ° 11,000	70,000 11,000
		9 000	£ 300	4 000		10,000
11.	Condenser Pit-Size Increment	3,900	4,200	4,900	5,600	
	TOTAL ITEMS 1 - 11	13,683,100	13,556,300	13,485,500	15,254,100	15,239,350
	TOTAL CONSTANT COST	5,191,500	.5,191,500	5,191,500	5,191,500 20 665 500	5,191,500 20,430,850
1.0	TOTAL TURBINE PLANT COST	18,874,600	18,747,800	18,677,000	20,445,600	20,430,030
12.	Piping In Containment Vessel	268,800	222,200	222,500	222,500	222,500 20,653,350
	GRAND TOTAL	19,143,400	18,970,000	18,899,500	20,668,100	20,653,350

SUMMARY OF COST DATA
600 PSIA, 686 F THROTTLE STEAM
(200 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	5	4	3	2	1
1. Turbine Generator and Accessories					•
a. Turbine generator unit	7,770,000	7,770,000	7,770,000	7,770,000	9,715,000
b. Turbine generator erection	390,000	390,000	390,000	390,000	419,000
 c. Reserve exciter d. Turbine foundation 	167,000	167,000	Constant 167,000	167,000	190,000
2. Condensers) 881,000	894,500	908,000	948,500	1,016,000
 a. Shells and accessories b. Dry vacuum pumps)		,		
c. Tubes	495,000	502,500	510,000	532,500	570,000
d. Steam jet air equipment	15,750	15,750	14,000 150,000	14,000 156,000	21,000 166,000
e. Erection	146,000 None	148,000	130,000		45,600
f. Deaeration - hot well of cond. g. L-P htrs. in exhaust stack	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System A - Structures a. Crib house a'. Substructure b'. Superstructure c'. Steel d'. Miscellaneous))) 514,000	518,000	523,000	536,000	560,000
b. Dredging c. Intake flume or forebay d. Seal well e. Discharge flume f. Outfall B - <u>Crib House Equipment</u> (erected)))))				
a. Traveling screens b. Screen wash pumps c. Screen wash piping d. Chlorination equipment) 144,000 }	146,000	148,000	154,000	163,000
e. Chlorine handling C - Circulating Water Piping	506,000	508,000	513,000	521,000	538,000
D - Circulating Water Pumps a. Pumps	212,000	214,000	218,000	226,000	242,000
b. Motors	156,000	157,500	159,500	163,500	171,500 21,900
c. Erection	19,900	20,000	20,200	20,800	21,500
4. Feed Water Heaters			51 500	E1 000	_
A - L-P Closed Heaters	100,000	100,500	51,500 64,000	52,900	70,600
B - H-P Closed Heaters	142,000 112,500	67,700 110,000	108,000	107,000	•
C - <u>Deaerating Heater</u> D - <u>Insulation</u>	112,300	110,000	142,11	,	
a. Closed heaters	4,050	1,950	1,450		-
b. Deserating	8,250	8,050	7,900	7,800	-
E - Structural Work	.,	7,000	7 ,00 0		
a, For closed heaters	14,000 23,800	23,100	22,700	22,400	-
b. For deaerating heater	,	,			
5. Boiler Feed Pumps	92,500	89,500	, 86,500	85,500	83,500
a. Pumps and base place b. Fluid drive	71,100	71,100	71,100	71,100	71,100
c. Motors	141,000	131,000	127,500	122,500	125,500 11,400
d. Exection	12,900	12,400 4,100	11,9 0 0 3,9 5 0	11,700 3,900	3,750
e. Foundations for pumps	4,250	0,100	3,,,,		•
6. Condensate Pumps	35,100	35,400	26,700	27,900	-
a, Pumps b. Motors	20,100	20,300	13,000	13,500	•
c. Erection	5,300	5,400	5,200	5,300	-
7. Piping and Insulation a. Extraction steam					
b. Heater vents and drains	158,700	130,100	115,900	69,200	34,500 91,900
 Boiler feed piping 	115,000	86,500	86,500	85,300	71,900
d. Condensate piping	}				
a¹. From condensate pumps thru L-P heaters	61,500	61,500	61,700	61,700	-
b'. For D.C. heater and)	•			
B.F. pump suction) 20 700	28,700	23,500	23,500	23,500
e, Main steam	28,700	20,700	25,50	,	•
8. Demineralizing Equipment and	174,000	169,000	162,000	160,000	155,000
Condensate Storage Tanks		109,000	107,800	107,800	91,600
9. Electrical	109,000	109,000	107,000	107,000	,
10. <u>Turbine Room Building</u> a. Building	-	-	-	•	70,000 11,000
 Turbine generator sub-base 	-	•	- 	3 200	
11. Condenser Pit-Size Increment	2,100	2,500	2,800	3,900	5,600
TOTAL ITEMS 1 - 11	12,872,500	12,746,050	12,669,300	12,652,200	14,697,950
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
		17,937,550	17,860,800	17,843,700	19,889,450
TOTAL TURBINE PLANT COST	18,064,000			221,700	221,700
 Piping in Containment Vessel 	282,600	236,000	221,700		
GRAND TOTAL	18,346,500	18,173,550	18,082,500	18,065,400	20,111,150

TABLE 12.3 (Continued)

SUMMARY OF COST DATA
600 PSIA, 886 F THROTTLE STEAM
(400 F SUPERMEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	5	4	3	2	1
Turbine Generator and Accessories					
a. Turbine generator unit	7,930,000	7,930,000	7,930,00Q	7,930,000	7,930,000
 b. Turbine generator erection 	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter d. Turbine foundation	167,000	167,000	Constan	167,000	167,000
	167,000	147,000	107,009	107,000	107,000
<u>Condensers</u> a. Shells and accessories) 773,000	786,500	800,000	840,500	881,000
b. Dry vacuum pumps)				
c. Tubes	435,000	442,500	450,000	472,500	495,000
d. Steam jet air equipment	19, 250	19,250	17,500	17,500	22,750
e. Erection	132,000	134,000	136,000	140,000	146,000
f. Deaeration - hot well of cond.	None 20,000	20,000	10,000	10,000	39,700 10,000
g. L-P htrs. in exhaust stack	20,000	20,000	10,000	10,000	10,000
Circulating Water System					
A - Structures a. Crib house)				
a'. Substructure	'				
b'. Superstructure	Ś				
c'. Steel	474,000	478,000	485,000	495,000	514,000
d'. Miscellaneous)	•	1		
b. Dredging)		1		
 c. Intake flume or forebay)		+		
d. Seal well)]		
e. Discharge flume	Į.		İ		
f. Outfall	,		i		
B - Crib House Equipment (erected) a. Traveling screens	1		į		
b. Screen wash pumps) 128,000	130,000	132,000	137,000	144,000
c. Screen wash piping)			•	•
d. Chlorination equipment)				
e. Chlorine handling)		1		
C - Circulating Water Piping	478,000	481,000	486,000	493,000	506,000
D - Circulating Water Fumps					010 000
a. Pumps	186,000	188,000	192,000	199,000	212,000
b. Motors c. Erection	143,000	144,500	146,000	150,000	157,500 19,900
	18,300	18,400	18,700	19,100	19,900
Feed Water Heaters A - L-P Closed Heaters	93,000	96,700	47,500	48,500	_
B - H-P Closed Heaters	130,000	64,800	60,000		66,000
C - Descrating Heater	104,000	102,000	100,500	99,700	-
D - Insulation	204,000	102,000	240,000	,	
a. Closed heaters	3,600	1,750	1,350	-	-
b. Desersting	7,700	7,500	7,400	7,350	-
E - Structural Work					
 a. For closed heaters 	14,000	7,000	7,000		-
 For deserating heater 	21,800	21,200	20,900	20,700	-
Boiler Feed Pumps					
a. Pumps and base plate	84,500	82,500	80,000	79,500	78,000
b. Fluid drive	71,100	71,100	71,100	71,100	71,100
c. Motors	119,500	111,500	109,000	105,000	108,000
d. Erection	11,600	11,200	10,800 3,600	10,700 3,550	10,500 3,500
e. Foundations for pumps	3,850	3,700	3,600	3,550	3,500
Condensate Pumps				0/ 000	
a. Pumps	30,200	30,500	23,200	24,200	•
b. Motors	17,600	17,700	11,600	11,900	•
c. Erection	4,800	4,800	4,700	4,800	-
Piping and Insulation					
a. Extraction steam) 149,400	120,800	99,900	59,800	34,500
b. Heater vents and drains) 01 200	94 500	94 500	46 200	91,900
c. Boiler feed piping	91,200	86,500	86,500	45,300	91,900
d. Condensate piping a'. From condensate pumps	}				
thru L-P heaters) 61,500	61,500	57,200	57,200	
b'. For D.C. heater and B.F.)	02,000	2.,-9	**,***	
pump suction	<u> </u>				
e. Main steam	56,800	56,800	56,800	56,800	56,800
Danis 1 d - d					
Demineralizing Equipment and Condensate Storage Tanks	158,000	153,000	148,000	147,000	144,000
Electrical	105,100	105, 100	102,500	102,500	81,500
Turbine Room Building					
	•	-	- i	-	-
a. Building	-	-	- !	-	-
		-	<u>.</u>	1,100	2,100
b. Turbine generator sub-base	-	-			
b. Turbine generator sub-base Condenser Pit-Size Increment	•			10 413 000	12,302,750
b. Turbine generator sub-base Condenser Pit-Size Increment	12,632,800	12,546,800	12,468,750	12,417,300	12,002,700
b. Turbine generator sub-base <u>Condenser Pit-Size Increment</u> TOTAL ITEMS 1 - 11	12,632,800				5,191,500
b. Turbine generator sub-base <u>Condenser Pit-Size Increment</u> TOTAL ITEMS 1 - 11 TOTAL CONSTANT COST	12,632,800 5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
b. Turbine generator sub-base <u>Condenser Pit-Size Increment</u> TOTAL ITEMS 1 - 11 TOTAL CONSTANT COST TOTAL TURBINE PLANT COST	12,632,800 5,191,500 17,824,300	5,191,500 17,738,300	5,191,500 17,650,2 5 0	5,191,500 17,608,800	5,191,500 17,574,250
b. Turbine generator sub-base <u>Condenser Pit-Size Increment</u> TOTAL ITEMS 1 - 11 TOTAL CONSTANT COST	12,632,800 5,191,500	5,191,500	5,191,500	5,191,500	5,191,500

600 PSIA, 986 F THROTTLE STEAM (500 F SUPERHEAT) 300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	5	4	3	2	1
Turbine Generator and Accessories	0 170 000	9 170 000	8,170,000	8,170,000	8,170,000
a. Turbine generator unit b. Turbine generator erection	8,170,000 390,000	8,170,000 390,000	390,000	390,000	390,000
c. Reserve exciter			Constant		\longrightarrow
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000
Condensers) 732,500	732,500	759,500	773,000	800,000
a. Shells and accessories b. Dry vacuum pumps)	152,500	.57,502	,	
c. Tubes	412,500	412,500	427,500	435,000	450,000
d. Steam jet air equipment	19,250	19,250	17,500	17,500	22,750
e. Erection	126,000	126,000	130,000	132,000	136,000
f. Descration - hot well of cond.	None		10.000	10,000	36,000
g. L-P htrs. in exhaust stack	20,000	20,000	10,000	10,000	10,000
Circulating Water System A - Structures a. Crib house a'. Substructure))				
b'. Superstructure c'. Steel d'. Miscellaneous	5 3 457,000	460,000	466,000	474,000	493,000
b. Dredging c. Intake flume or forebey d. Seal well e. Discharge flume f. Outfall B - Crib House Equipment (Erected)))))				
 a. Traveling screens b. Screen wash pumps c. Screen wash piping d. Chlorination equipment 	121,000	122,000	125,000	128,000	136,000
e. Chlorine handling C - Circulating Water Piping	, 466,000	468,000	472,000	478,000	492,000
D - Circulating Water Pumps a. Pumps	175,000	177,000	180,000	186,000	198,000
b. Motors	137,000	138,000	140,000	143,000	149,500
c. Erection	17,500	17,500	17,900	18,200	19,000
Peed Water Heaters	,				
A - L-P Closed Heaters	89,000	89,500	45,800	46,500	2
B - H-P Closed Heaters	125,000	60,000	58,800	- '	63,900
C - Descrating Heater	101,000	99,000	97,500	97,000	•
D - Insulation					
a. Closed heaters	3,400	1,650	1,300		-
b. Deaerating	7,450	7,300	7,200	7,200	-
E - Structural Work	14 000	7,000	7,000	_	_
 a. For closed heaters b. For deaerating heater 	14,000 21,000	20,500	20,300	20,100	-
-	21,000	20, 300	10, 300	20,100	
Boiler Feed Pumps		** ***		77.000	74 000
a. Pumps and base plate	81,500	79,500	77,500	77,000	76,000 71,100
b. Fluid drive c. Motors	71,100	71,100	71,100 101,500	71,100 98,000	101,500
d. Erection	111,000 11,000	103,500 10,700	10,400	10,300	10,100
e. Foundations for pumps	3,650	3,550	3,450	3,400	3,350
	•,	-,	-,		-,-
Condensate Pumps a. Pumps	28,200	28,400	21,700	22,000	-
a. rumps b. Motors	16,600	16,700	11,000	11,300	-
c. Brection	4,600	4,600	4,500	4,600	-
Piping and Insulation	• •	•	•		
a. Extraction steam) 149,400	120,800	99,900	59,800	34,500
b. Heater vents and drains)		a	40.000	01 000
c. Boiler feed piping d. Condensate piping a'. From condensate pumps	91,200	86,500	86,500	45,300	91,900
thru L-P heaters b'. For D.C. heater and B.F.	57,000	57,000	55,600	55,600	•
pump suction e. Main steam	65,700	65,700	65,700	65,700	65,700
Demineralizing Equipment and	,		•		,
Condensate Storage Tanks	150,000	147,000	143,000	141,000	139,000
Blectrical	100, 200	98,400	97,600	102,500	81,500
	,	, . ,	,		
Turbine Room Building a. Building	-	-	-		-
b. Turbine generator sub-base		-	- *	: • .	-
Condenser Pit-Size Increment	-	•	- "	•	-
TOTAL ITEMS 1 - 11	12,712,750	12,598,150	12,559,750	12,460,100	12,407,800
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	17,904,250	17,789,650	17,751,250	17,651,600	17,599,300
TANKE TANDENE STREET AND				423,500	423,500
T1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.					
Piping in Containment Vessel GRAND TOTAL	424,900	423,500	423,500	425,500	18,022,800

SUMMARY OF COST DATA
400 PSIA, 445 F THROTTLE STRAM (SATURATED STRAM)
300 MWe INDIRECT CYCLE TURBINE PLANT

THROTTLE FLOW, #/HR.	4,366,000	4,134,000	3,930,000	3,833,000
HEATER ARRANGEMENT	4	3	2	1
Turbine Generator and Accessories				
a. Turbine generator unit	10,785,000	10,785,000	10,785,000	10,785,000
b. Turbine generator erection c. Reserve exciter	422,000	422,000	422,000	422,000
d. Turbine foundation	195,000	195,000	195,000	195,000
Condensers				
a. Shells and accessories	1,128,000	1,140,000	1,176,000	1,260,000
b. Dry vacuum pumps c. Tubes	,			
d. Steam jet air equipment	808,400 15,750	817,000 14,000	842,800 14,000	903,000 17,500
e. Erection	173,000	174,500	179,000	190,000
f. Deseration - hotwell of cond	-	_	-	-
g. L.P. htrs. in exhaust stacks	20,000	10,000	10,000	10,000
Circulating Water System A - Structures				
a. Crib house	}			
a'. Substructure	í			
b'. Superstructure c'. Steel)			
d'. Miscellaneous	3			
b. Dredging	559,000	563,000	574,000	601,000
c. Intake flume)	•		• • • •
d. Seal well e. Discharge flume	1			
f. Outfall	í		!	
B - Crib House Equipment (Erected)			1	
 Traveling screens Screen wash pumps 	,			
c. Screen wash piping) 162,000	164,000	168,000	179,000
d. Chlorination equipment)	,	,	2.7,500
e. Chlorine handling	F25 000	*** ***		
C - Circulating Water Piping D - Circulating Water Pumps	535,000	538,000	546,000	565,000
a. Pumps	234,360	236,685	243,660	261,330
b. Motors	181,145	182,465	186,425	191,880
c. Erection	21,620	21,770	22,220	23,360
Feed Water Heaters	*** ***			
A - L-P closed heaters B - H-P closed heaters	128,000 70,000	57,500 76,000	59,000	67,000
C - Deaerating heater	126,000	123,000	121,000	-
D - Insulation			ļ , , ,	
a. Closed heaters	2,400	2,650		•
b. Deaerating E - Structural Work	9,300	9,100	8,800	•
a. For closed heaters	7,000	7,000	_	-
b. For deserating heater	28,000	27,000	26,000	-
Boiler Feed Pumps				
a. Pumps and base plate b. Fluid drive	75,000	67,500	64,500	60,000
c. Motors	60,000 94,700	60,000 , 96,025	60,000 87,205	60,000 93,820
d. Erection	13,500	12,000	11,700	10,500
e. Foundations for pumps	5,100	4,800	4,650	4,350
Condensate Pumps			•	
a. Pumps	56,700	34,200	35,400	-
b. Motors c. Erection	30,550 6,550	16,780 6,200	17,320 6,350	
Piping and Insulation	0,550	0,200	0,550	
a. Extraction steam) 137,100	135,900	82,100	49,200
b. Heater vents and drains)		İ	•
c. Boiler feed piping	70,000	70,000	26,700	58,600
d. Condensate piping a'. From condensate pumps)		!	
thru L.P. heaters) 79,700	68,800	72,800	-
b'. For D.C. heater and B.F.	}			
pump suction e. Main steam) 35,700	34,000	32,700	32,700
Demineralizing Equipment and	23,700	34,000	32,700	32,700
Condensate Storage Tanks	194,000	187,500	181,500	179,000
Electrical	109,700	107,900	107,900	89,300
Turbine Room Building	• • •		1	,
a. Building	83,000	83,000	83,000	83,000
b. Turbine generator sub-base	13,000	13,000	13,000	13,000
Condenser Pit-Size Increment	11,900	12,250	13,300	15,750
TOTAL ITEMS 1 - 11	16,687,175	16,575,525	16,478,030	16,472,790
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	21,878,675	21,767,025	21,669,530	21,664,290
Piping in Containment Vessel	297,000	280,000	262,000	
GRAND TOTAL				253,000
	22,175.675	22,047,025	21,931,560	21,917,290

400 PSIA, 545 F THROTTLE STEAM (100 F SUPERHEAT) 300 MHG INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	4	3	2	1	
1. Turbine Generator and Accessories		0.005.000	0 005 080	10 565 000	
a. Turbine generator unit b. Turbine generator erection	9,995,000 419,000	9,995,000 419,000	9,995,0 0 0 419,000	10,545,000 419,000	
c. Reserve exciter		(onstant —	\longrightarrow	
d. Turbine foundation	190,000	190,000	190,000	190,000	
2. Condensers	\ 1 0E6 E00	1 056 500	1,080,000	1,165,000	
a. Shells and accessories b. Dry vacuum pumps) 1,056,500	1,056,500	1,000,000	1,105,000	
c. Tubes	592,500	592,500	774,000	835,000	
d. Steam jet sir equipment	15,750	14,000	14,000 166,000	17,500 177,000	
 e. Erection f. Deseration - hot well of cond. 	172,000 None	172,000		52,400	
g. L-P htrs. in exhaust stack	20,000	10,000	10,000	10,000	
3. Circulating Water System					
A - Structures)		İ		
a. Crib house a'. Substructure	3				
b'. Superstructure)				
c'. Steel) 574,000	577,000	539,000	566,000	
d'. Miscellaneous b. Dredging) 3/4,000	377,000	222,1422	****	
c. Intake flume or forebay)		•		
d. Seal well	?				
e. Discharge flume f. Outfall	Ś				
B - Crib House Equipment (Erected)					
a. Traveling screens)				
b. Screen wash pumps c. Screen wash piping	169,000	170,000	155,000	166,000	
d. Chlorination equipment)				
e. Chlorine handling) 548,000	550,000	524,000	543,000	
C - Circulating Water Piping D - Circulating Water Pumps	540,000	555,555	i		
a. Pumps	250,000	252,000	228,000	246,000 184,500	
b. Motors	176,000 22,300	177,000 22,400	175,000 20,900	22,000	
c. Erection 4. Feed Water Heaters	22,500		- 1		
A - L-P Closed Heaters	118,100	56,700	55,400		
B - H-P Closed Heaters	63,200	69,200	115,000	63,000	
C - <u>Deserating Heater</u> D - <u>Insulation</u>	119,500	117,000	115,000		
a. Closed heaters	2,150	1,950	-	-	
b. Descrating	8,750	8,550	8,400	-	
B - Structural Work a. For closed heaters	7,000	7,000	-	-	
b. For descrating heater	25,600	25,000	24,400		
5. Boiler Feed Pumps			74 500	52,000	
at Pumps and base plate	65,000 71,100	59,000 71,100	56,500 71,100	71,100	
b. Fluid drivec. Motors	121,500	119,500	112,500	115,000	
d. Erection	11,700	10,500	10,000	9, 20 0 4,100	
e. Foundations for pumps	4,650	4,400	4,300	4,100	
6. Condensate Pumps	51,200	31,400	32,500	-	
a. Pumps b. Motors	27,600	15,500	15,900	•	
c. Erection	6,100	5,800	5,900	-	
7. Piping and Insulation) 127 100	135,000	82,100	49,200	
 e. Extraction steam h. Heater vents and drains) 137,100	133,000			
c. Boiler feed piping	90,900	90,900	40,900	84,800	
d. Condensate piping)		1		
a'. From condensate pumps through L-P heaters) 59,600	62,700	62,700	-	
b'. For D.C. heater and)	•	!		
B.F. pump suction) 20,800	20,800	20, 800	20,800	
e. Main steam	20,000	20,000			
8. Demineralizing Equipment and Condensate Storage Tanks	190,000	180,000	175,000	168,000	
9. Electrical	147,000	127,700	127,700	88,300	
10. Turbine Room Building			:	05.000	-
a. Building	70,000	70,000	70',000 11',000	83,000 13,000	٠. ٠
b. Turbine generator sub-base	11,000	11,000	10,300	13,000	
11. Condenser Pit-Size Increment	6,600	6,600			
TOTAL ITEMS 1 - 11	15,646,200	15,504,700	15,402,300	15,972,900 5,191,500	
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	21,164,400	
TOTAL TURBINE PLANT COST	20,837,700	20,696,200	20,593,800 203,600	203,600	
12. Piping in Containment Vessel	250,700	244,000		21,368,000	
GRAND TOTAL	21,088,400	20,940,200	20,797,400	21,300,000	

SUMMARY OF COST DATA
400 PSIA, 645 F THROTTLE STEAM
(200 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

_	HEATER ARRANGEMENT	- 4	3	2	1
ι.	Turbine-Generator And Accessories		i.		
	a. Turbine generator unit	7,890,000	9,995,000	9,995,000	9,995,000
	b. Turbine generator erection	390,000	419,000	419,000 Constant -	419,000
	c. Reserve exciter d. Turbine foundation	167,000	190,000	190,000	190,000
		207,000	,		•
٠.	Condensers) 975,500	989,000	1,016,000	1,080,000
	a. Shells and accessories b. Dry vacuum pumps) 9/5,500	,0,,000	2,,,,,,,,,	-,,
	c. Tubes	547,500	555,000	570,000	774,000
	d. Steam jet air equipment	15,750	14,000	14,000	17,500
	e. Erection	160,000	162,000	166,000	166,000
	f. Descration - hot well of cond.	None	10.000	10,000	48,600 10,000
	g. L-P. htrs. in exhaust stack	20,000	10,000	10,000	10,000
	Circulating Water System A - Structures a. Crib house	}			
	a'. Substructure b'. Superstructure	{			
	c'. Steel) 546,000	552,000	58,000	539,000
	d'. Miscellaneous b. Dredging) 340,000	332,000	130,000	*******
	c. Intake flume or forebay	Ś			
	d. Seal well)			
	e. Discharge flume)		į	
	f. Outfall)		!	
	B - Crib House Equipment (erected)	`		1	
	a. Traveling screens b. Screen wash pump	Ś			
	c. Screen wash piping) 158,000	160,000	163,000	155,000
	d. Chlorination Equipment)		į.	
	e. Chlorine handling)	520 000	i da= 000	52/- 000
	C - Circulating Water Piping	528,000	532,000	\$37,000	524,000
	D - Circulating Water Pumps	232,000	236,000	240,000	228,000
	a. Pumps b. Motors	167,000	169,000	71,000	174,500
	c. Erection	21,200	21,400	21,700	20,900
	Feed Water Heaters	,		'	
	A - L-P Closed Heaters	111,000	52,100	52,400	-
	B - H-P Closed Heaters	52,800	64,200	<u>-</u> '	59,500
	C - Deserating Heater	114,000	112,000	110,000	-
	D - <u>Insulation</u>				
	a. Closed heaters	1,750	1,800	9 050	_
	b. Deserating	8,350	8,200	8,050	
	E - <u>Structural Work</u> a. For closed heaters	7,000	7,000	-	_
	b. For deaerating heater	24,300	23,600	23,200	•
		= 7:			
	Boiler Feed Pumps a. Pumps and base plate	58,500	53,000	51,000	47,500
	b. Fluid drive	71,100	71,100	71,100	71,100
	c. Motors	110,000	109,000	103,000	106,500
	d. Erection	10,400	9,400	8,900	8,300
	e. Foundations for pumps	4,350	4,150	4,050	3,900
	Condensate Pumps				
	a. Pumps	46,800	29,000	29,800	<u>-</u>
	b. Maters	25,400	14,500	14,800	-
	c. Erection	5,700	5,500	5,600	-
	Piping And Insulation				
	a. Extraction steam)		1	
	b. Heater vents and drains) 136,000	135,000	80,000	49,200
	c. Boiler feed piping	90,900	90,900	40,900	84,800
	d. Condensate piping	\			
	a'. From condensate pumps through L-P heaters) 69,600	62,700	62,700	•
	b', For D.C. heater and)	-=,		
	B.F. pump suction)		1	4
	e. Main steam	20,800	20,800	20,800	20,800
	Demineralizing Equipment And			ţ	
	Condensate Storage Tanks	179,000	170,000	167,000	160,000
	14. A			123,700	86,300
	Electrical	143,700	123,700	123,700	20,200
	Turbine Room Building		70.000	70,000	70,000
	a. Building	-	70,000 11,000	11,000	11,000
	b. Turbine generator sub-base	-	11,000	ĺ	
	Condenser Pit-Size Increment	4,600	4,900	5,600	10,300
	TOTAL ITEM 1 - 11	13,114,000	15,258,750	15,144,300	15,130,700
	TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500
			-,	· · · · · · · · · · · · · · · · · · ·	
			20.450.250	20,335.800	20,322.200
	TOTAL TURBINE PLANT COST	18,305,500	20,450,250	20,335,800	20,322,200
			20,450,250 250,700	20,335,800	20,322,200

400 PSIA, 845 F THROTTLE STEAM (400 F SUPERHEAT) 300 MW INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	4	3	2	111
Turbine Generator and Accessories				
a. Turbine generator unit	8,050,000	8,050,000	8,050,000	8,050,000 167,000
b. Turbine generator erection	167,000	167,000	le7,000	167,000
c. Reserve exciter d. Turbine foundation	167,000	167,000	167,000	167,000
Condensers				240 500
a. Shells and accessories b. Dry vacuum pumps) 840,500)	854,000	881,000	948,500
c. Tubes	472,500	480,000	495,000	532,500
d. Steam jet air equipment	19,250	17,500	17,500	21,000
e. Erection	140,000	142,000	146,000	156,000 42,600
 f. Deseration - hot well of cond. g. L-P htrs. in exhaust stack 	None 20,000	10,000	10,000	10,000
Circulating Water System			·	
A - Structures				
a. Crib house)			
a'. Substructure b'. Superstructure) 3 499,000	503,000	512,000	536,000
c'. Steel)	,	' '	
d'. Miscellaneous	j			
b. Dredging)			
c. Intake flume or forebay)			
d. Seal well	₹		i	
e. Discharge flume f. Outfall	ζ			
B - Crib House Equipment (erected)	, ′			
a. Traveling screens	()		i	000
b. Screen wash pumps) 138,000	140,000	144,000	154,000
c. Screen wash piping)		i.	
d. Chlorination equipment)			
e. Chlorine handling	496,000	498,000	504,000	522,000
C - Circulating Water Piping	470,000	4,0,000	,	
D - Circulating Water Pumps a. Pumps	202,000	204,000	210,000	226,000
b. Motors	151,000	152,500	155,500	164,000
c, Erection	19,300	19,400	19,900	20,800
Feed Water Heaters			40.000	_
A - L-P Closed Heaters	100,000	46,900 47,500	48,000	54,500
B - H-P Closed Heaters	53,500	104,000	102,500	3.,
C - Deserating Hester	106,000	104,000	102,500	
D - Insulation a. Closed heaters	1,750	1,600	-	•
b. Deaerating	7,700	7,600	7,600	•
E - Structural Work				
a. For closed heaters	7,000	7,000	21,300	-
b. For deaersting heater	22,100	21,600	11,500	
Boiler Feed Pumps		4.2 500	42,000	39,50
a. Pumps and base plate	47,500 60,000	43,500 60,000	60,000	60,00
b. Fluid drive	93,500	92,500	88,000	92,50
c. Motors d. Erection	8,400	7,500	7,300	6,80
e. Foundations for pumps	3,900	3,750	3,700	3,60
Condensate Pumps			1	
a. Pumps	39,800	24,800	25,600	-
b. Motors	22,000	12,700	13,100 5,000	
c. Erection	5,100	4,900	3,000	
Piping and Insulation			:	
a. Extraction steam)) 132,600	114,700	69,300	49,20
b. Heater vents and drains) 132,600 76,100	76,100	40,900	84,80
 c. Boiler feed piping d. Condensate piping)			
a'. From condensate pumps	ý			
thru L-P heaters) 61,500	61,700	61,700	-
b'. For D.C. heater and)			
B.F. pump suction) 37,800	37,200	37,200	37,20
e. Main steam	57,000	0,,,,,		
Demineralizing Equipment and	161 000	155,000	152,000	147,00
Condensate Storage Tanks	161,000			84,60
Electrical	128,200	116,200	116,200	04,00
Turbine Room Building				_
a. Building	•	•	-	
b. Turbine generator sub-base			2 100	3,90
Condenser Pit-Size Increment	1,100	1,400	2,100	
TOTAL ITEMS 1 - 11	12,558,100	12,452,550	12,382,300	12,381,0
	5,191,500	5,191,500	5,191,500	5,191,50
TOTAL CONSTANT COST	•			
TOTAL TURBINE PLANT COST	17,749,600	17,644,050	17,573,800	17,572,50
	267 200	287,200	286,200	286,20
. Piping in Containment Vessel	357,200	#07,		

SUMMARY OF COST DATA
400 PSIA, 945 F THROTTLE STEAM
(500 F SUPERHEAT)
300 HWE INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	4	3	2	1
· · · · · · · · · · · · · · · · · · ·	4			*
a. Turbine Generator and Accessories a. Turbine generator unit	8,130,000	8,130,000	8,130,000	8,130,000
b. Turbine generator erection	390,000	390,000	390,000	390,000
c. Reserve excitér		147.000	- Constant	
d. Turbine foundation	167,000	167,000	167,000	167,000
Condensers a. Shells and accessories) 786,500	800,000	813,500	881,000
b. Dry vacuum pumps) /60,500	000,000	013,500	002,000
c. Tubes	442,500	450,000	457,500	495,000
d. Steam jet air equipment	19,250	17,500	17,500	21,000
 e. Erection f. Deseration - hot well of cond. 	134,000 None	136,000	138,000	146,000 39,700
g. L-P htrs. in exhaust stack	20,000	10,000	10,000	10,000
Circulating Water System				
A - Structures				
 a. Crib house a'. Substructure 	}			
b'. Superstructure	ś			
c'. Steel) 480,000	482,000	489,000	513,000
d'. Miscellaneous	}			
 b. Dredging c. Intake flume or forebay 	{			
d. Seal well	Ś			
e. Discharge flume	}			
f. Outfall B - Crib House Equipment (erected))		1	
a. Traveling screens)		1	
b. Screen wash pumps) 130,000	132,000	134,000	144,000
 c. Screen wash piping d. Chlorination equipment)		1	
e. Chlorine handling	,			
C - Circulating Water Piping	482,000	484,000	489,000	505,000
D - Circulating Water Pumps	100 000	101 000	106 000	211,000
a. Pumps b. Motors	189,000 145,000	191,000 145,500	196,000	156,000
c. Erection	18,400	18,600	18,800	19,800
Feed Water Heaters				
A - L-P Closed Heaters	96,000	45,500	46,000	*
B - H-P Closed Heaters	52,200 102,000	55,000	99,000	52,500
C - Deserating Heater D - Insulation	102,000	100,000	99,000	"
a. Closed heaters	1,700	1,500	-	•
b. Deserating	7,500	7,400	7,000	•
E - Structural Work a. For closed heaters	7,000	7,000	_	_
b. For deserating heater	21,300	20,800	20,600	. .
Boiler Feed Pumps				
a. Pumps and base plate	43,500	39,500	38,500	36,500
b. Fluid drive	60,000	60,000	60,000	60,000
c. Motors d. Erection	89,000 7,600	86,000 6,800	82,000 6,600	86,500 6,200
e. Foundations for pumps	3,750	3,600	3,550	3,450
Condensate Pumps	-,			
a. Pumpa	37,000	23,100	23,800	-
b. Motors	20,600	12,000	12,300	•
c. Erection	4, 800	4,600	4,700	-
Piping and Insulation a. Extraction steam) 132,600	114,700	69,300	49,200
b. Heater vents and drains) 132,600	114,700	03,300	77, 200
c. Boiler feed piping	76,100	76,100	40,900	84,800
d. Condensate piping)			
 a'. From condensate pumps thru L-P heaters) 61,500	61,700	61,700	_
b'. For D.C. heaters and B.F. pump suction	{	24,700	-1,	
e. Main Steam	42,100	42,100	39,300	39,300
Demineralizing Equipment	•		i .	•
and Condensate Storage Tanks	155,000	148,000	146,000	143,000
Electrical	128, 200	112,400	114,400	79,000
Turbine Room Building		_		
a. Building b. Turbine generator sub-base	-	-	-	•
	_	_	400	2,100
Condenser Pit-Size Increment	13 403 100	12 503 400		
TOTAL ITEMS 1 - 11	12,683,100	12,581,400	12,474,350	12,471,050
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	17,874,600	17,772,900	17,665,850	17,662,550
Piping in Containment Vessel	380,600	380,600	299,400	299,400

SUMMARY OF COST DATA
165 PSIA, 366 F THROTTLE STEAM (SATURATED STEAM)
300 NWe INDIRECT CYCLE TURBINE PLANT

THROTTLE FLOW, #/HR.		4,802,000	4,631,000	4,456,000
Heater arrangement		3	12	1
Turbine Generator and Accessories		11 0/5 000	11 045 000	11 065 000
a. Turbine generator unit b. Turbine generator erection		11,965,000 430,000	11,955,000 4 3 0,000	11,965,000 430,000
c. Reserve exciter		С	onstant -	
d. Turbine foundation		200,000	20,000	200,000
Condensers				
a. Shells and accessories)	1,356,000	1,380,000	1,488,000
b. Dry vacuum pumps c. Tubes	,	971,800	989,000	1,066,400
d. Steam jet air equipment		14,000	14,000	15,750
e, Brection		203,000	206,500	220,000 62,000
f. Deseration - hot well of cond.g. L-P htrs. in exhaust stacks		10,000	10,000	10,000
		20,000	,,,	* *
Circulating Water System A - Structures				
a. Crib house)			
a'. Substructure	?			
b'. Superstructure c'. Steel	}			
d'. Miscellaneous	5	633,000	640,000	673,000
b. Dredging	•	•		
c. Intake flume	?			
d. Seal well e. Discharge flume	}		1	
f. Outfall	Ś		1	
B - Crib House Equipment (Erected)			i	
a. Traveling acreens)		1	
 b. Screen wash pumps c. Screen wash piping 	}	192,000	195,000	208,000
d. Chlorination equipment	ś	2,2,000	,	•
e. Chlorine handling)			
C - Circulating Water Piping		589,000	593,000	617,000
D - Circulating Water Pumps a. Pumps		282, 255	286,440	307,830
b. Motors		208, 160	210,625	222,680
c. Brection		24,710	24,980	26,360
Feed Water Heaters				
A - L-P closed heaters		65,500	67,000	71,000
B - H-P closed heaters C - Descrating heater		59,000 132,000	130,000	71,000
D - Insulation		152,000	7,,,,,	
a. Closed heaters		2,200	-	-
b. Deserating		9,800	9,600	•
E - Structural Work a. For closed heaters		7,000		
b. For descrating heater		29,500	28,500	•
Boiler Feed Pumps				
a. Pumps and base plate		75,000	75,000	75,000
b. Fluid drive		42,900	42,900	60,000
c. Motors		61,410 12,000	55,455 10,400	71,550 10,400
d. Erection e. Foundations for pumps		5,250	5,100	5,100
Condensate Pumps		•		
a. Pumps		51,600	53,400	-
b. Motors		21,530	.22, 180	-
c. Erection		5,950	6,100	-
Piping and Insulation				
a. Extraction steam b. Heater vents and drains	}	128,800	90,100	49,200
c. Boiler feed piping	•	64,800	39,400	87,600
d. Condensate piping)			
a'. From condensate pumps	?		72,800	_
thru L-P heaters b'. For D-C heater and B.F.	}	72,800	72,800	-
pump suction	5			
e. Main steam		53,000	51,700	50,400
Demineralizing Equipment and			i	
Condensate Storage Tanks		206,000	201,500	196,500
Blectrical		108,300	108,800	91,100
Turbine Room Building		_		
TOTOLIO MOTIO DELL'AND		96,000	96,000	96,000
a. Building		15,000	15,000	15,000 22,400
a. Building b. Turbine generator sub-base				
a. Building b. Turbine generator sub-base		18,600	19,300	-
a. Building b. Turbine generator sub-base			18,344,780	-
a. Building b. Turbine generator sub-base Condenser Pit-Size Increment		18,600		18,413,270
ă. Building b. Turbine generator sub-base <u>Condenser Fit-Size Increment</u> TOTAL ITEMS 1 - 11 TOTAL CONSTANT COST		18,600 18,421,865 5,191,500	18,344,780 5,191,500	18,413,270 5,191,500
ă. Building b. Turbine generator sub-base Gondenser Fit-Size Increment TOTAL ITEMS 1 - 11		18,600 18,421,865	18,344,780	18,413,270 5,191,500 23,604,770 404,000

TABLE 12.4 (SI-2008, p 5)

Summary of 500-MWe H₂O Turbine Plant Characteristics Efficiency in %, Cost in Millions of Dollars

	1				,											
10 · Ou	MO. Of Feed-mater neathers			_	-		-1	•	-		m			A.	_	_
Pressure Peia	Degrees F Superheat	Act. Stem Temp. *F	~	Cost	*	Cost	r	Cost	~	15	~	S t	~	Cost	~	3
	SAT.	2%	36.3	30.56	35.9	29.86	35.4	29.51	34.7	29.22	11.8	20 05	45 2	28 05	6 12	8
	90	969	37.1	29.64	36.8	29.02	7.92	28,64	35.7	28.43	8	28,19	2	3	2	, 2
1500	8	%	38.4	78.64	38.1	28.02	27.6	27.66	36.8	27.17	35.0	3	2	8	2	3 5
•	38	8	39.7	27.98	39.2	27.68	38.6	27.45	37.8	27.26	*	3 5		3 8	2.5	3 5
	007	%	40.7	28.27	6.04	8.72	39.7	27.64	80	27.12	17.7	2	*	3 8	, .	3 5
	SAT.	287	35.9	30.44	35.6	29.93	35.1	29.53	3.4	29.25	33.5	8	12	20.02	*	18
	8	687	36.8	29.53	36.5	78:35	8,0	28.65	35.4	3.82	37.6	8	33.5	8	2	8
0071	8	787	8	28.48	37.8	28.06	37.2	27.72	36.6	27.52	35.7	27.34	7	27.11	33.3	2
	8	887	39.2	28.07	38.0	27.72	۳, 8,	27.45	37.5	27.27	36.6	27.13	35.4	2,03	7	7,7
	87	286	6.04	28.27	40.1	27.89	39.4	27.68	×	27.50	37.5	27.36	%	2.5	35.0	27.32
	SAT.	2 67			35.1	31.24	34.8	30.80	34.3	30.48	33.5	30.28	32.7	30.07	31.2	8
;	90	667			8,5	59:03	35.9	8.30	35.3	28.51	34.5	28.33	33.4	8	35.5	8
1200	8	192			37.3	8.3	37.1	27.89	8.5	27.53	35.7	27.10	7.	27.25	33.2	27.22
	8	967			8,5	27.80	38.2	27.58	31.7	27.37	36.8	7.7	35.6	27.07	7,	2
	007	8			39.6	27.92	39.4	27.72	38.8	27.51	37.8	27.39	36.5	27.23	35.0	27.16
	SAT.	545			34.1	30.98	33.9	30.64	33.4	30.33	32.6	30.20	31.7	35.0g	2.00	30,02
	2	Ť			35.3	28.78	35.1	28.66 56.66	34-4	28.47	33.7	28.35	32.8	38.13	31.6	38.06
707	8	74.5			36	27.67	36°	2.5	35.6	27.18	* *	27.05	33.8	8.3	35.5	% 8
	35	ŝ			9.0	N .	37.4	2	9,0	3,3	35.0	8:3	8	8	3.4	56.69
	442	200			2	201.00		7 - 4	200	4:17	2	2/11/	32.8	27:04	34.2	88.68
	9	819			3.4	2,5	7 2	* 5 2 2 3 3	3,5	8 9	3,50	2,2	e :	9.5	2.5	8 8
8	8	718			3.5	3		15	1	3	200	; ;	4 5	77.75	2 5	200
	38	818			36.6	27.11	1,4	12	, ;	1 3		8 % 8 %	2 6	2 2	10	; ¥
	- 200	1018			8.80	27.59	0.8	77.72	4.6	70.12	8.0	12:12		12.12		
	SAT.	987					31.6	87.00	31.3	30.25	30.7	30.06	×	29.92	8,85	29.85
į	8	3					32.8	59.62	32.4	29.43	31.8	29.32	20	29.17	29.8	3
8	8	36					33.9	28.88	33.6	28.69	32.9	7.78	32.0	28.19	8	8
	<u>ş</u>	8					7,9	4:12	35.9	23.80	35.3	38.83	ž	26.76	35.6	8.66
	8	8					37.3	07.72	37.1	21.23	36.4	27.16	35.3	27.05	33.5	26.99
	SAT.	\$ 1							29.1	30.48	28.7	8.8	.: 8	30.05	0.12	28.63
3	8	7							ģ	3.5	8,5	29.37	23.5	29.15	6.12	6. 8.
3	3 5	3							ä	29.15	Z.	8 8	Х 4	8.83	8	28.73
	3 5	£ 5	•						7	5.75	o A	× ×	ž,	28.40	8.0	28.46
	3	7							35.3	21.33	35.2	27.21	33.9	26.97	31.8	27.02

TABLE 12.5 (SI-2008, pp 114-148)

SUMMARY OF COST DATA 1500 PSIA, 596 THROTTLE STEAM (SATURATED STEAM)

500 MWe INDIRECT CYCLE TURBINE PLANT

J00 1	1110 11101	11101 02					
Heater Arrangement	7	- 6	3	4	3	2	1
1. Turbine Generator and Accessories							
A. Turbine generator unit	13,480,000	13,480,000	13,480,000	13,480,000	13,480,000	13,480,000	13,480,000
B. Turbine generator erection	560,000	560,000	560,000	560,000	560,000	560,000	560,000
C. Reserve exciter D. Turbine foundation	280,000	280,000	280,000	CONSTANT 280,000	280,000	280,000	280,000
2. Condensers							
A. Shells and accessories B. Dry vacuum pumps	1,326,000	1,326,000	1,330,000	1,340,000	1,370,000	1,440,000	1,550,000
C. Tubes	945,000	945,000	950,000	956,000	975,000	1,020,000	1,097,000
D. Steam jet air equipment	19,250	19,250	17,500	17,500	17,500	17,500	35,00
E. Erection	222,000	222,000	223,000	225,000	228,000	237,000	252,000
F. Deseration - hot well of	NONE						69,70
cond. G. L-P heaters in exhaust stack	28,000	28,000	28,000	28,000	14,000	14,000	14,00
A. Structures A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging	667,000	667,000	668,000	670,000	674,000	684,000	699,00
3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall B. Crib house equipment (erected) 1. Traveling screens 2. Screen wash pupps 3. Screen wash piping	137,000	137,000	137,000	138,000	139,000	142,000	147,00
4. Chlorination equipment 5. Chlorine handling	}			4			
C. Circulating water piping	656,000	656,000	657,000	659,000	667,000	683,000	710,00
D. Circulating water pumps 1. Pumps	319,000	319,000	320,000	323,000	330,000	346,000	372,00
2. Motors	183,000	183,000	184,000	185,000	189,000	198,000	214,00
3. Erection	25,100	25,100	25,100	25,300	25,600	26,200	27,30
4. Feed Water Heaters							
A. L-P closed heaters	230,500	227,500	138,500	141,000	70,000	75,000	129 00
B. H-P closed heaters	511,500 235,000	296,500 225,000	268,500 218,400	128,000 213,200	104,000 209,800	206,600	128,00
C. Deserating hester D. Insulation	233,000	225,000	110,400	213,100	20,,000	200,000	
1. Closed heaters	16,200	11,100	8,200	4,900	1,800		
2. Deaerators	17,300	16,500	16,100	15,700	15,400	15,300	
E. Structural work		21 222	14 000	7 000	7,000		
 For closed heaters For deaerators 	28,000 50,400	21,000 47,600	14,000 45,800	7,000 44,600	43,600	43,000	
	30,100	47,500	,				
5. Boiler Feed Pumps A. Pumps and base plates	408,000	380,000	351,000	338,000	320,000	314,000	302,0
B. Fluid drive	222,000	222,000	222,000	161,000	161,000	161,000	161,0
C. Motors	472,000	427,000	400,000	378,000	360,000	355,000	342,0
D. Erection	37,300	35,000	32,600	31,400	30,100	29,600	28,7
E. Foundation for pumps	7,400	7,000	6,500	6,200	6,000	5,800	5,7
6. Condensate Pumps						50 000	
A. Pumps	83,000	82,000	63,000	65,000	48,000	52,000	
B. Motors	52,900	44,700 8,100	32,000 7,500	32,700 7,600	22,100 7,000	23,600 7,500	
C. Erection	8,200	8,100	7,500	7,000	,,,,,,,	.,	
7. Piping and Insulation	- 7			ļ			
A. Extraction steam B. Heater vents and drains	400,300	340,000	294,000	248,000	220,000	146,000	81,2
C. Peed water piping	283,500	225,100	170,400	157,000	157,000	90,000	185,2
D. Condensate piping	7	•	·				
 From condensate pumps through L-P heaters. 	123,600	123,600	113,300	113,300	103,200	103,200	
To deserator and B.F.]			:			
pump suction		20.000	20,000	30,000	22,500	22,500	22,5
E. Main steam	30,000	30,000	30,000	30,000	22,500	22,550	,5
8. Demineralizing Equipment	001 000	210.000	900 000	300.000	104 000	190,000	188,0
and Condensate Storage Tanks	236,000	219,000	208,000	200,000	194,000	-	
9. Electrical	217,800	208,400	200,100	195,600	191,200	192,300	164,1
O. Turbine Room Building	89,000	89,000	89,000	89,000	89,000	89,000	89,0
Total Items 1-10	22,607,250	22,133,450	21,788,500	21,494,000	21,331,800	21,749,100	21,204,4
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,5
Total Turbine Plant Cost	29,849,750	29,375,950	29,031,000	28,736,500	28,574,300	28,491,600	28,446,9
ll. Piping In Containment Vessel	714,000	483,500	483,000	479,000	475,000	470,000	478,5
Grand Total	30,563,750	29,859,450	29,514,000	29,215,500	29,049,300	28,961,600	28,925,4

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
1500 PSIA, 696 THROTTLE STEAM
(100 F SUPERMEAT)
500 MMe INDIRECT CYCLE TURBINE PLANT

		···					
Heater Arrangement		. 6	3	- 4	3		1
A. Turbine Generator and Accessories A. Turbine generator unit	13,000,000	13,000,000	13,000,000	13,000,000	13,000,000	13,000,000	13,000,000
B. Turbine generator erection	560,000	560,000	560,000	560,000	560,000	560,000	560,000
C. Reserve exciter				— CONSTANT			
D. Turbine foundation	280,000	280,000	280,000	280,000	280,000	280,000	280,000
2. Condensers	1 060 000		1 420 000				
A. Shells and accessories B. Dry vacuum pumps	1,260,000	1,262,000	1,270,000	1,230,000	1,300,000	1,340,000	1,420,000
C. Tubes	897,000	899,000	907,000	917,000	927,000	956,000	1,015,000
D. Steam jet air equipment	19,250	19,250	17,500	17,500	17,500	17,500	35,000
E. Brection F. Descration - hot well of	213,000 None	214,000	215,000	216,000	218,000	225,000	235,000
cond.	Lyoupa				,		63,900
G. L-P heaters in exhaust stack	28,000	28,000	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System				l			
A. Structures							
1. Crib house a. Substructure							
b. Superstructure				†			
c. Steel				1			
d. Miscellaneous	658,000	658,000	659,000	6\$1,000	664,000	670,000	682,000
2. Dredging 3. Intake flume or forebay							
4. Seal well				1			
5. Discharge flume							
6. Outfall B. Crib house equipment (erected)				ř.			
1. Traveling screens				1			
2. Screen wash pumps	134,000	134,000	134,000	135,000	126 000	120 000	142.000
3. Screen wash piping	234,000	134,000	134,000	175,000	136,000	138,000	142,000
4. Chlorination equipment 5. Chlorina handling				:			
C. Circulating water piping	640,000	640,000	642,000	644,000	650,000	659,000	681,000
D. Circulating water pumps	202 000	204 220	206 000	200 000	212 222		2/2 000
1. Pumps 2. Motors	303,000 174,000	304,000 174,000	306,000 175,000	308,000 177,000	313,000 180,000	323,000 186,000	342,000 197,000
3. Erection	24,400	24,400	24,500	24,600	24,900	25,300	26,100
4. Feed Water Heaters					•	•	-
A. L-P closed heaters	206,500	205,000	128,000	129,500	65,000	68,000	
B. H-P closed heaters	457,500	269,500	246,000	118,000	98,000		119,000
C. Descrating heater D. Insulation	217,000	209,600	204,000	20,600	133,300	131,800	
1. Closed heaters	14,700	9,900	7,400	4,400	1,600		
2. Deserators	16,000	15,400	15,100	14,800	9,900	9,800	
E. Structural work 1. For closed heaters	28,000	21,000	14,000	7,000	7 000		
2. For deaerators	45,500	43,500	42,200	41,200	7,000 29,800	29,300	
5. Boiler Feed Pumps.	•				,		
A. Pumps and base plates	356,000	335,000	313,000	302,000	289,000	284,000	275,000
B. Fluid drive	222,000	222,000	161,000	161,000	161,000	161,000	161,000
C. Motors D. Erection	447,000	410,000	388,000	368,000	352,000	340,000	336,000 26,500
E. Foundation for pumps	33,100 6,600	31,300 6,200	29,500 5,800	28,700 5,700	27,700 5,400	27,300 5,300	5,200
5. Condensate Pumps	-,		-,	,	•••	•••	
A. Pumps	73,500	73,000	56,500	18,000	44,000	46,500	
B. Motors	46,900	46,500	29,100	29,600	20,500	21,500	
C. Brection	7,400	7,300	6,800	6,900	6,500	6,800	
. Piping and Insulation							
A. Extraction steam B. Heater vents and drains	400,300	340,000	294,000	248,000	220,000	146,800	81,200
C. Feed water piping	282,700	240,000	177,100	163,500	163,500	97,000	199,500
D. Condensate piping				-	-	-	
1. From condensate gumps	10/ 000	10/ 000	02 200	2 200	70 000	20 200	
through L-P heaters. 2. To deserator and B.F.	104,800	104,000	92,200	92,200	78,300	78,300	
pump suction				j			
E. Main steam	22,800	22,800	22,800	22,800	19,700	19,700	19,700
. Demineralizing Equipment				_1_			
and Condensate Storage Tanks	206,000	194,000	186,000	180,000	176,000	173,000	171,000
. Electrical	209,900	202,300	185,000	191,300	187,200	186,200	159,300
. Turbine Room Building	89,000	89,000	89,000	89,000	89,000	89,000	89,000
Total Items 1-10	21,683,850	21,293,950	20,910,500		20,468,800	20,315,100	20,335,400
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	28,926,350		28,153,000		27,711,300	27,557,600	27,577,900
. Piping In Containment Vessel Grand Total	714,000	483,500	483,000 28,636,000	479,000 28,431,800	475,000 28 186 300	470,000 28,027,600	478,500 28,056,400
Avenue Incet	29,640,350	29,019,950			28,186,300	-0,027,000	_0,000,400

SUMMARY OF COST DATA
1500 PSIA, 796 F THROTTLE STEAM
(200 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

_	Heater Arrangement	7	6	3	4	3	2	1
1.	Turbine Generator and Accessories							
	A. Turbine generator unit	12,280,000	12,280,000	12,280,000		12,280,000	12,280,000	12,280,000
	B. Turbine generator erection	560,000	560,000	560,000	560,000	560,000	560,000	560,000
	G. Reserve exciter	* ***	290 000		STANT	280,000	280,000	280,000
	D. Turbine foundation	280,000	280,000	280,000	280,000	280,000	200,000	200,000
2.	Condensers	1,186,000	1 104 000	1,206,000	1,214,000	1,240,000	1,310,000	1,360,000
	A. Shells and accessories	1,100,000	1,194,000	1,200,000	2,224,000	2,240,000	2,520,000	,,
	B. Dry vacuum pumps	840,000	850,000	857,000	866,000	885,000	915,000	973,000
	C. Tubes D. Steam jet air equipment	19,250	19,250	17,500	17,500	17,500	17,500	35,000
	E. Erection	203,000	205,000	206,000	208,000	213,000	217,000	227,000
	F. Deseration - hot well of	None						61,200
	cond.							
	G. L-P heaters in exhaust stack	28,000	28,000	28,000	28,000	14,000	14,000	14,000
3.	Circulating Water System A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous	646,000	648,000	650,000	652,000	656,000	662,000	673,000
	2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall B. Crib house equipment (erected) 1. Traveling acreeme	·	ŕ	·	,	•	,	,
	2. Screen wash pumps 3. Screen wash piping 4. Chlorination equipment	130,000	131,000	131,000	132,000	133,000	135,000	139,000
	5. Chlorine handling C. Circulating water piping D. Circulating water piping	620,000	623,000	626,000	629,000	637,000	646,000	665,000
	D. Circulating water pumps 1. Fumps	284,000	287,000	290,000	293,000	299,000	309,000	328,000
	2. Motors	163,000	165,000	166,000	168,000	172,000	178,000	188,000
	3. Erection	23,600	23,800	23,900	24,000	24,300	24,700	25,500
,	Feed Water Heaters							
٠.	A. L-P closed heaters	190,500	191,000	120,500	121,500	61,500	64,000	
	B. H-P closed heaters	425,500	252,500	232,000	112,000	94,000		114,000
	C. Deserating heater	205,600	199,400	131,700	129,300	127,400	125,100	****
	D. Insulation	10.000	2 000	4 900	. 4 100	1,500		
	1. Closed heaters	12,800	9,000 14,700	6,800 9,800	4,100 9,600	9,400	9,300	
	2. Deserators B. Structural work	15,200	14,700	,,000	,,,,,,	3, 100	2,000	
	1. For closed heaters	28,000	21,000	14,000	7,000	7,000		
	2. For deaerators	42,600	41,000	29,300	28,500	27,900	27,500	
5	Boiler Feed Pumps				· .			
٠.	A. Pumps and base plates	325,000	308,000	289,000	281,000	270,000	266,000	259,000
	B. Fluid drive	222,000	161,000	161,000	161,000	161,000	161,000	161,000
	C. Motors	397,000	368,000	350,000	335,000	320,000 26,100	312,000 25,800	310,000 25,200
	D. Brection	30,500 6,000	29,200 5,700	27,700 5,400	27,000 5,300	5,100	5,000	4,900
	E. Foundation for pumps	0,000	3,700	2,400	3,350	3,	-,	
6.	Condensate Pumps			E 2 222	E 9 500	A1 E00	42 EDA	
	A. Pumps	66,500	66,000	.53,000 27,000	53,500 27,500	41,500 19,400	43,500 20,300	
	B. Motors C. Erection	42,700 6,800	42,500 6,700	6,400	6,500	6,200	6,400	
_		0,000	0,700	0,-00	3,550	0,200	٠, .,٠	
7.	Piping and Insulation							
	A. Extraction steam	400,300	335,000	294,000	247,700	200,000	146,800	81,200
	B. Heater vents and drains C. Feed water piping	282,700	240,000	177,100	163,500	163,500	97,000	199,500
	D. Condensate piping					-	•	-
	 From condensate pumps through L-P heaters. 	104,800	104,800	92,200	92,200	78,300	78,300	
	2. To descrator and B.F.				i			
	pump suction B. Main steam	58,200	58,200	58,200	58,200	44,400	44,400	44, 400
8.	Demineralizing Equipment and Condensate Storage Tanks	188,000	179,000	173,000	168,000	164,000	162,000	161,000
9.	Electrical	196,600	190,700	184,800	182,000	178,900	178,300	151,900
	Turbine Room Building	89,000	89,000	89,000	89,000	89,000	89,000	89,000
	-	20,599,150	20,206,450	19,853,300	19,660,900	19,506,900	19,409,900	19,409,800
	Total Items 1-10	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
	Total Constant Cost	27,841,650	27,448,950	27,095,800	26,903,400	26,749,400	26,652,400	
11	Total Turbine Plant Cost	798,500	567,000	567,000	563,500	549,500	549,500	549,500
	Piping In Containment Vessel Grand Total	28,640,150	28,015,950	27,662,800	27,466,900	27,298,900	27,201,900	

1500 PSIA, 896 F THROTTLE STEAM (300 F SUPERHEAT) 500 MWE INDIRECT CYCLE TURBINE PLANT

Heate	Arrangement	7	6	3	——————————————————————————————————————	3	2	1
1. Turbine Gene	rator and Accessories							
A. Turbine (enerator unit	12,280,000	12,280,000	12,280,000	12,280,000	12,280,000	12,280,000	12,280,00
	enerator erection	540,000	540,000	540,000	540,000	540,000	540,000	540,00
C. Reserve of D. Turbine i		280,000	280,000	280,000	— CONSTANT 280,000	280,000	280,000	280,00
2. Condensers	oundation.	200,000				200,000	400,000	
A. Shells ar	d accessories	1,110,000	1,108,000	1,120,000	1,130,000	1,156,000	1,200,000	1,270,00
B. Dry vacuu	m pumps							
C. Tubes		788,000	791,000	800,000	808,000	825,000	855,000	905,00
D. Steam jet	air equipment	19,250	19,250	17,500	17,500	17,500	17,500	35,00
E. Erection F. Deseration	n - hot well of	193,000 None	194,000	195,000	196,000	201,000	206,000	215,00
cond.	u - not well of	Иотф						57,20
	rs in exhaust stack	28,000	28,000	28,000	28,000	14,000	14,000	14,00
. Circulating	Water System							
A. Structure	•							
l. Crib h								
	structure							
د. Ste	erstructure							
	ellaneous	635,000	626 000	620 000		£10.000	fra 200	
2. Dredgi:		\$ 033,000	636,000	638,000	640,000	643,000	650,000	659,0
	flume or forebay							
4. Seal w								
5. Discha:								
6. Outfall					!			
B. Crib house	equipment (erected)				i			
	ng screens							
	wash piping (> 126,000	127,000	127,000	128,000	129,000	131,000	134,0
4. Chlorin	ation equipment				į			
5. Chloria	e handling				i			
C. Circulatin	g water piping	601,000	603,000	606,000	608,000	614,000	625,000	642,00
D. Circulatin	g water pumps				i			
1. Pumps		264,000	267,000	270,000	273,000	278,000	289,000	306,0
2. Motore		152,000	153,000 23,000	155,000 23,100	157,000 23,200	160,000 23,400	166,000 23,900	175,0 24,5
3. Erectio		22,900	23,000	23,100	23,200	23,400	23,700	24, 3
. Feed Water Re								
A. L-P closed		182,500	182,500	114,000	115,500	58,000	60,000	110.0
B. H-P closed		401,500	240,000 129,200	222,500	107,500 124,400	91,500 122,900	121,900	110,0
C. Deserating D. Insulation	neacer	133,000	117,200	126,400	224,400	122,500	121,500	
1. Closed	neaters	11,800	8,400	6,300	3,800	1,400		
2. Demerat		9,900	9,600	9,300	9,200	9,100	9,000	
E. Structural	work				ļ.			
	sed heators	28,000	21,000	14,000	7,000	7,000		
2. For dea	rators	29,700	28,500	27,700	27, 100	26,600	26,500	
Boiler Feed P		201 000	007 000	070 000	264 222	857 000	850 000	847.0
A. Pumps and I		301,000	287,000	272,000	266,000	257,000	253,000	247,0
B. Fluid drive	:	161,000 361,000	161,000 337,000	161,000 322,000	161,000 310,000	128,000 300,000	128,000 292,000	128,0 290,0
C. Motors D. Erection		28,600	27,400	26,300	25,700	25,000	24,700	24,3
E. Foundation	for numne	5,600	5,400	5,100	5,000	4,900	4,800	4,7
					3"			
Condensate Pur A. Pumps	ps	62,000	61,500	49,500	50,000	39,000	41,000	
B. Motors		39,400	39,300	25,400	25,700	18,200	19,100	
C. Frection		6,300	6,300	6,000	6,100	5,800	6,100	
					F			
Piping and Ins A. Extraction								
B. Heater vent		391,500	335,000	294,000	245,500	197,500	144,500	81,2
C. Feed water	piping	229,200	210,000	177,100	163,500	163,500	97,000	199,5
D. Condensate					1-			
	densate pumps				1			
	L-P heaters.	104,800	104,800	92,200	92,200	75,900	75,900	
	etor and B.F.				1			
pump suc E. Main steam		74,500	74,500	67,000	67,000	67,000	67,000	67,0
	.	,	,		- 11		** • • • •	
Demineralizing	Equipment	175,000	168,000	162,000	158,000	156,000	155,000	154,0
and Condensate	atorage Tanks							
Electrical		186,100	181,300	176,400	174,200	171,400	171,600	145,1
Turbine Room B	uilding	178,000	178,000	178,000	178,000	178,000	178,000	178,0
Total Items 1-		20,139,550	19,844,950	19,613,800	19,431,100	19,264,600	19,157,500	19,165,50
Total Constant		7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,50
		27,382,050	27,087,450	26,856,300	26,673,600	26,507,100	26,395,000	26,408,0
Total Turkin-			41,000,0400		-010.5000	,, 200		
Total Turbine				592.000	589.500	589.500	589.500	589.50
Total Turbine Piping In Cont Grand Total		664,000 27,979,650	595,000 27,682,450	592,000 27,448,300	589,500 27,263,100	589,500 27,096,600	589,500 26,984,500	589,50 26,997,

1500 PSIA, 996 P THROTTLE STEAM (400 P SUPERHEAT) 500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	7	6	- 3	4	3	2	1
1. Turbine Generator and Accessories							
A. Turbine generator unit. B. Turbine generator erection	12,640,000 540,000	12,640,000 540,000	12,640,000 540,000	12,640,000 540,000 STANT	12,640,000 540,000	12,640,000 540,000	12,640,000 540,000
C. Reserve excitor D. Turbine foundation	280,000	280,000	280,000	280,000	280,000	280,000	280,000
2. Condensers A. Shells and accessories B. Dry vacuum pumps	1,060,000	1,062,000	1,064,000	1,074,000	1,090,000	1,130,000	1,194,000
C. Tubes	753,000	755,000	760,000	766,000	780,000	805,000	850,000
D. Steam jet air equipment	19,250	19,250	17,500	17,500	17,500	17,500	35,000
E. Erection F. Deseration - hot well of	185,000 None	186,000	187,000	188,000	192,000	196,000	205,000 → 53,700
cond. G. L-P heaters in exhaust stack	28,000	28,000	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System A. Structures 1. Crib house a. Substructure b. Superstructure							
c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall	628,000	629,000	630,000	631,000	634,000	639,000	648,000
B. Crib house equipment (erected) 1. Traveling screens					i		
2. Screen wash pumps 3. Screen wash piping 4. Chlorination equipment	124,000	124,000	125,000	125,000	126,000	128,000	131,000
5. Chlorine handling C. Circulating water piping	588,000	590,000	592,000	593,00	598,000	608,000	624,000
D. Circulating water pumps	252,000	254,000	256,000	258,000	262,000	272,000	287,000
1. Pumps 2. Motors	145,000	146,000	147,000	148,000	151,000	156,000	165,000
3. Erection	22,400	22,400	22,500	22,600	22,800	23,200	23,800
. Feed Water Heaters A. L-P closed heaters	172,000	172,000	109,000	110,500	55,500	58,500	
B. H-P closed heaters	384,500	230,500	214,000	104,000	88,500		106,500
C. Deserating heater D. Insulation	128,000	124,200	121,800	120,000	118,700	117,700	
 Closed heaters 	9,000	7,900	6,000	3,600	1,400	0.700	
2. Deaerators	9,400	9,100	9,000	8,800	8,700	8,700	
B. Structural work For closed heaters 	28,000	21,000	14,000	7,000	7,000		
2. For deaerators	28,100	27,000	26,300	25,800	25,400	25,200	
. Boiler Feed Pumps	284,000	272,000	258,000	252,000	244,000	242,000	236,000
A. Pumps and base places B. Fluid drive	161,000	161,000	128,000	128,000	128,000	128,000	128,000
C. Motors	333,000	311,000	300,000	290,000	281,000	275,000	273,000
D. Erection	27,200	26,300	25,200	24,700		23,800	23,40
E. Foundation for pumps	5,300	5,100	4,900	4,800	4,700	4,600	4,500
. Condensate Pumps A. Pumps	58,500	58,000	46,500	47,500	37,500	39,000	
B. Motors	36,900	36,800	23,800	24,300	17,300	18,100	
C. Erection	5,900	5,900	5,600	5,700	5,500	5,700	
. Piping and Insulation A. Extraction steam				-			
B. Heater vents and drains	391,500	327,000	294,000	245,500	197,500	144,500	81,20
C. Feed water piping D. Condensate piping	229,200	210,000	177,100	156,100	156,100	97,000	199,50
1. From condensate pumps through L-P heaters. 2. To deserator and B.F. pump suction	98,000	98,000	83,100	83,100		75,900	
E. Main steam	90,500	83,800	83,800	83,800	83,800	83,800	83,80
. Demineralizing Equipment and Condensate Storage Tanks	165,000	159,000	154,000	151,000	149,000	148,000	147,00
. Blectrical	178,200	174,100	169,800	167,700	165,300	165,300	139,20
. Turbine Room Building	178,000	178,000	178,000	178,000	178,000	178,000	178,00
Total Items 1-10	20,265,850	19,973,350	19,720,900		19,400,100	19,287,500	19,290,60
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,50
Total Turbine Plant Cost	27,508,350	27,215,850	26,963,400		26,642,600	26,530,000	
. Piping In Containment Vessel	761,000	678,500	678,500	674,000		674,000	
Grand Total	28,269,350	27,894,350	27,641,900	27,449,500	27,316,600	27,204,000	21,201,10

SUMMARY OF COST DATA
1400 PSIA, 587 F THROTTLE STEAM
(SATURATED STEAM)
500 MM: INDIRECT CYCLE TURBINE PLANT

Washing Superson							
Heater Arrangement	7		3	<u> </u>	3	2	
A. Turbine Generator and Accessor A. Turbine generator unit	13,530,000	13,530,000	13,530,000	13.530.00	0 13,530,000	13,530,000	13.530.000
B. Turbine generator erection	560,000	560,000	560,000	560,00		560,000	560,000
C. Reserve exciter				- CONSTAIR			
D. Turbine foundation	280,000	280,000	280,000	280, d 0	0 280,000	280,000	280,000
2. Condensers				-			
A. Shells and accessories	1,342,000	1,344,000	1,347,000	1,350,40	0 1,400,000	1,485,000	1,595.000
B. Dry vacuum pumps	J						
C. Tubes	958,000	963,000	970,000	980,00		1,041,000	1,140,000
D. Steam jet air equipment E. Erection	19,250 225,000	19,250 226,000	17,500 228,000	17,50 229,00		17,500 241,000	33,250 259,000
F. Deseration - hot well of	NONE						→ 71,800
cond.							
G. L-P heaters in exhaust stack	k 28,000	28,000	28,000	28,00	0 14,000	14,000	14,000
3. Circulating Water System							
A. Structures -	7			İ			
1. Crib house	1						
a. Substructure b. Superstructure	1			!			
c. Steel	1						
d. Miscellaneous	671,000	671,000	673,000	675,00	0 679,000	688,000	707,000
2. Dredging	ſ			1			
 Intake flume or forebay Seal well 	1						
5. Discharge flume	Ì						
6. Outfall	ノ						
B. Crib house equipment (erecte	(b						
1. Traveling screens	}						
 Screen wash pumps Screen wash piping 	> 138,000	138,000	139,000	139,00	0 141,000	144,000	150,000
4. Chlorination equipment	ļ						
5. Chlorine handling	ل			i.			
C. Circulating water piping	661,000	662,000	665,000	667,00	0 675,000	691,000	724,000
D. Circulating water pumps	324,000	325,000	328,000	331,00	0 338,000	354,000	386,000
1. Pumps 2. Motors	186,000	187,000	188,000	190,00		203,000	222,000
3. Erection	25,300	25,400	25,400	25,50	0 25,900	26,500	27,900
4. Feed Water Heaters							
A. L-P closed heaters	210,000	208,500	125,500	127,00	0 60,000	63,000	
B. H-P closed heaters	473,000	280,000	259,000	123,50			114,000
C. Deserating heater	233,600	223,200	21/,400	212,20	0 208,800	205,600	
D. Insulation 1. Closed heaters	15,900	10,900	8,100	4,80	p 1,500		
2. Deserators	17,200	16,500	16,000	15,60		15,200	
E. Structural work				T.			
 For closed heaters 	28,000	21,000	14,000	7,00			
2. For deaerators	50,000	47,200	45,600	44,20	0 43,400	42,800	
5. Boiler Feed Pumps							807 000
A. Pumps and base plates	373,000	348,000	323,000	310,00		290,000 161,000	281,000 161,000
B. Fluid drive C. Motors	222,000 437,000	222,000 397,000	161,000 374,000	161,00 354,00	0 336,000	324,000	323,000
D. Erection	36,700	34,500	32,400	31,20	0 29,900	29,400	28,700
E. Foundation for pumps	7,300	6,800	6,400	6,20	0 5,900	5∤, 800	5,600
6. Condensate Pumps							
A. Pumps	83,000	82,500	52,000	53,00		52,500 25,000	
B. Motora	49,600 8,200	49,000 8,100	30,600 7,500	31,20 7,60	0 23,500	7,500	
C. Erection	0,20	0,230	,,500	, , 00	,,230	.,	
7. Piping and Insulation	٦						
A. Extraction steam	401,000	348,000	302,000	250,00	0 197,000	138,000	81,200
B. Heater vents and drains C. Peed water piping	269,000	225,100	170,400	157,00		89,700	
D. Condensate piping	7			-			
 From condensate pumps 	123,600	123,600	113,300	113,30	00 103,200	103,200	
through L-P heaters.	7 223,000	123,000	113,300		,0 ,00,00	103,200	
To deserator and B.F. pump suction							
E. Main steam	30,000	30,000	30,000	30,00	0 22,500	22,500	22,500
8. Demineralizing Equipment	•	•		}			
and Condensate Storage Tanks	233,000	217,000	207,000	199,00	0 193,000	190,000	188,000
9. Electrical	210,800	202,400	195,100	191,20	187,000	186,800	161,900
10. Turbine Room Building	89,000	89,000	89,000	89 00	00 89,000	89,000	89,000
		-	21,758,200	1	0 21,368,100	21,316,000	21,341,050
Total Items 1-10	22,548,450 7,242,500	22,148,950 7,242,500	7,242,500		0 7,242,500	7,242,500	7,242,500
Total Constant Cost Total Turbine Plant Cost	29,790,950	29,391,450	29,000,700		0 28,610,600	28,558,500	28,583,550
11. Piping In Containment Vessel	654,000	542,000	525,000	489 00		459,000	450,000
Grand Total	30,444,950	29,933,450	29,525,700		0 29,075,600	29,017,500	29,033,550
			•	ì			

SUMMARY OF COST DATA
1400 PSIA, 687 F THROTTLE STEAM
(100 F SUPERHEAT)
500 MM= INDIRECT CYCLE TURBINE PLANT

	Heater Arrangement	7	6	5	4	3	2	1
Ā.	thine Generator and Accessories Turbine generator unit Turbine generator erection	13,050,000 560,000	13,050,000 560,000	13,050,000 560,000	13,050,000 560,000	13,050,000 560,000	13,050,000 560,000	13,050,000 560,000
	Reserve exciter Turbine foundation	280,000	280,000	280,000	- CONSTANT - 280,000	280,000	280,000	280,000
A.	Shells and accessories	1,275,000	1,277,000	1,300,000	1,310,000	1,330,000	1,380,000	1,493,000
	Dry vacuum pumps Tubes	909,000	915,000	923,000	930,000	945,000	981,000	1,067,000
	Steam jet air equipment	19,250	19,250	17,500	17,500	17,500	17,500	33,250
	Erection	216,000 NONE	217,000	218,000	220,000	223,000	230,000	244,000 67,200
F.	Deseration - hot well of cond.	NONE			[•	0,,200
G.	L-P heaters in exhaust stack	28,000	28,000	28,000	28,000	14,000	14,000	14,000
	culating Water System Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous	660,000	661,000	662,000	665,000	668,000	675,000	690,000
в.	2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall Crib house equipment (erected) 1. Traveling screens	000,000	301,300	002 (300		333,	,	,
	2. Screen wash pumps 3. Screen wash piping 4. Chlorination equipment 5. Chlorine handling	135,000	135,000	135,000	136,000	137,000	140,000	145,000
c.	Circulating water piping Circulating water pumps	644,000	645,000	647,000	651,000	656,000	669,000	697,000
	1. Pumps	307,000	309,000	310,000	314,000	320,000	332,000	360,000
	2. Motors	175,000	177,000	178,000	180,000	184,000 25,100	190,000 25,600	206,000 26,700
	3. Erection	24,600	24,000	24,700	24,900	25,100	*3,000	20,700
	d Water Heaters L-P closed heaters	193,500	193,500	118,000	120,000	57,000	59,500	
	H-P closed heaters	427,000	256,000	238,000	114,000	85,000		107,000
С.	Deserating heater Insulation	216,400	208,800	204,000	200,000	133,200	131,700	
	1. Closed heaters	13,900	9,700	7,300	4,300	1,300		
	2. Deserators	15,900	15,400	15,000	14,800	9,900	9,800	
	Structural work 1. For closed heaters	28,000	21,000	14,000	7,000	7,000		
	2. For deserators	45,200	43,400	42,200	41,000	29,800	29,300	
	ler Feed Pumps Pumps and base plates	326,000	309,000	289,000	280,000	268,000	264,000	257,000
	Fluid drive	222,000	161,000	161,000	161,000	161,000	161,000	161,000
	Motors	420,000	387,000	367,000	348,000 28,600	332,000 27,500	322,000 27,200	320,000 26,500
	Erection Foundation for pumps	32,700 6,500	31,200 6,100	29,400 5,800	5,600	5,400	5,300	5,200
			-,		- 1	•	ŕ	-
	densate Pumps Pumps	73,500	73,000	47,000	48,000	44,500	47,000	
	Motors	44,100	43,800	27,900	28,400	21,800	22,900	
C. 1	Erection	7,400	7,300	6,900	7,000	6,600	6,900	
	ing and Insulation				İ			
	Extraction steam Heater vents and drains	401,000	348,000	302,500	250,000	197,000	138,300	81,200
C. 1	Feed water piping Condensate piping	268,500	240,000	177,100	163,500	163,500	96,600	199,500
:	1. From condensate pumps through L-P heaters. 2. To deserator and B.F.	104,800	104,800	92,200	92,200	85,000	85,000	
E. 1	pump suction	27,100	21,300	21,300	21,300	21,300	17,100	17,100
	ineralizing Equipment Condensate Storage Tanks	205,000	194,000	186,000	179,000	175,000	173,000	172,000
	ctrical	204,600	197,800	190,700	187,800	184,000	183,500	158,200
	bine Room Building	89,000	89,000	89,000	89,000	89,000	89,000	89,000
	al Items 1-10	21,654,950	21,258,350	20,964,500	20,756,900	20,514,400	20,413,200	20,526,850 7,242,500
	al Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	
	al Turbine Plant Cost	28,897,450	28,500,850	28,207,000	27,999,400	27,756,900	27,655,700 433,000	27,769,350 433,000
	ing In Containment Vessel	631,000 29,528,450	442,500 28,943,350	442,500 28,649,500	442,500 28,441,900	442,500 28,199,400	28,088,700	28,202,350
Gra	nd Total	430,430	40,743,330	20,049,000	-01441340	20,200,400	,,	,,,

SUMMARY OF COST DATA 1400 PSIA, 787 F THROTTLE STEAM (200 F SUPERHEAT) 500 MWE INDIRECT CYCLE TURBINE FLANT

2. Condensers 2. Dry vecum pumps 2. Dry vecum pumps 3. Street air equipment 3. Street air equipment 4. Stablis and accessories 2. Dry vecum pumps 4. Street air equipment 5. Exection 5. Description 6. Description 6. Left haters in exhaust stack 3. Circulating Water System 4. Structures 6. Substructure 6. Substructure 7. Substructure 7. Substructure 8. Description 8. Office house equipment (exected) 1. Traveling screens 1. Substructure 8. Office house equipment (exected) 1. Traveling screens 2. Street must pumps 1. Traveling screens 1. Traveling screens 1. Substructure 3. Street must pumps 1. Traveling screens 1. Substructure 3. Street must pumps 1. Traveling screens 1. Substructure 3. Street must pumps 1. Traveling screens 1. Substructure 3. Street must pumps 1. Traveling screens 1. Substructure 3. Street must pumps 1. Traveling screens 1. Substructure 3. Street must pumps 1. Traveling screens 1. Substructure 3. Street must pumps 1. Traveling screens 1. Substructure 3. Street must pumps 1. Traveling screens 1. Substructure 1. Substructure 3. Street must pumps 1. Traveling screens 1. Substructure 1. Sub			me ambining o	TOLE TURDING	LIMIT			
A. Purbine generator cunic 2. Purbine generator cunic 2. Purbine generator cunic 3. Purbine generator cunic 3. Purbine generator 3. Purbine foundation 3. Purbine foundation 3. Purbine foundation 3. Purbine foundation 3. Purbine generator 3. Purbine foundation 3. Purbine foundation 3. Purbine generator 3. Purbine foundation 3. Purbine foundation 3. Purbine foundation 3. Purbine foundation 3. Purbine foundation 3. Purbine foundation 3. Purbine foundation 3. Purbine foundation 3. Purbine foundation 4. Purbine foundation 3. Purbine foundation 4. Purbine foundation 4. Purbine foundation 4. Purbine foundation 3. Purbine foundation 4. Purbine foundation 4. Purbine foundation 5. Purbine foundation 5. Purbine foundation 5. Purbine foundation 5. Purbine foundation 5. Purbine foundation 5. Purbine foundation 5. Purbine foundation 5. Purbine foundation 5. Purbine foundation 6. Pu	Heater Arrangement	7	- 6	3	4	3	2	1
B. Turkine generator exection 560,000 36							1	
C. Reserve sortier D. Turbins foundation 20,000 280,000 280,000 280,000 280,000 280,000 280,000 280,000 280,000 280,000 280,000 280,000 280,000 280,000 280,000 280,000 280,000 280,000 280,000 280,000 1,260,000 1,310,000 1,300,000 1,310,000 1,400,000 1,310,								
2. Condemance A. Shalls and accessories B. Dry vacuum pumps C. Tubes Text sit equipment D. Tubes Text sit equipment D. Tubes Text sit equipment D. Tubes Text sit equipment D. Tubes D.	C. Reserve exciter		•				360,000	>00,00
A. Shalls and accessories B. Dry vector pumps C. Tubes C.		280,000	280,000	280,000	180,000	280,000	280,000	280,00
8. Dry vacuum pumps 1. Try vacuum pumps 1. Statem its clayingmant 1. 1,250 1. Statem its clayingmant 1. 1,250 1. Statem its clayingmant 1. 1,250 1. Statem its clayingmant 1. 1,250 1. Statem its clayingmant 1. Statem its clayin		1 200 000	1 210 000	1 220 000	1 360 000	1 260 000	1: 210, 000	1 600 00
D. Steam jet air squipment 19,250 19,250 17,500 17,500 17,500 17,500 220,000 220,000 20,000 20,000 20,000 211,000 213,000 220,000 220,000 20,000 20,000 211,000 213,000 220,000 220,000 20,000 211,000 213,000 220,000 220,000 20,000 211,000 213,000 220,000 220,000 20,000 20,000 211,000 213,000 20,000 214,000 144,000 14		2,200,000	1,210,000	2,220,000	1,100,000	1,200,000	1,510,000	1,400,00
E. Exection			865,000		\$83,000	901,000	931,000	997,00
### P. Deseration - hot well of cond. G. L.P hasters in exhaust stack 28,000 28,000 28,000 14,000 14,000 14,000 14,000 1. Circulating Water System A. Structures B. Superstructure C. Steal d. Miscallaneous 2. Dresging 3. Streem wash pumps 3. Streem wash pumps 3. Streem wash pumps 3. Streem wash pumps 3. Streem wash pumps 3. Street mash pining 4. Chlorination equipment 5. Chiolouse quipment (erected) 1. Tungs water pumps 2. Excess wash pumps 3. Street mash pining 4. Chlorination equipment 5. Chiolouse quipment 6. Outfall 5. Discharge flume 6. Outfall 7. Excess wash pumps 1. Tungs 1. Tungs 2. Excess wash pumps 2. Netors 3. Excestion 2. Excess wash pining 4. L.P-closed hasters 3. Excestion 2. Deserations 3. Excess wash pining 4. L.P-closed hasters 3. Excess wash pining 4. L.P-closed hasters 3. Excess wash pining 4. L.P-closed hasters 3. Excess wash pining 4. L.P-closed hasters 3. Excess wash pining 4. L.P-closed hasters 3. Excess wash pining 5. Haster wash pining 6. Syloo 28,000 294,000 294,000 294,000 398,000 394,000 394,000 395,000 394,000 395,000								33,25
Cond. C. 1-P haters in exhaust stack 28,000 28,000 28,000 14,000 14,000 14,000 16,000			207,000	209,000	211,000	213,000		232,00
G. 1P heaters in exhaust stack A. Structures 1. Orth house a. Substructure b. Superstructure c. Stresslamenous 2. Dresding 3. Intake flume or forebay 4. Seal uell 5. Hacharge flume 6. Outrail 5. Outrained supremant (crected) 1. Traveling soreman 2. Sorem usah piping 4. Chiorination equipment 5. Chiorination equipment 5. Chiorination equipment 6. Outrail 6. Outrail 7. Traveling soreman 2. Sorem usah piping 9. Circulating water piping 1. Traveling soreman 2. Sorem usah piping 9. Circulating water piping 1. Thumps 2. Motore 1. Thumps 2. Motore 1. Thumps 2. Motore 1. Ped Mater Baster A. LP closed heaters A. P closed heaters A. P closed heaters A. P closed heaters A. P closed heaters A. P closed heaters A. P closed heaters A. P closed heaters A. P closed heaters A. P clo		NONE						63,00
A. Structures 1. Crit house 2. Substructure 2. Substructure 3. Substructure 4. Substructure 6.		28,000	28,000	28,000	28,000	14,000	14,000	14,00
A. Structures 1. Crib house 2. Substructure 2. Substructure 3. Substructure 4. Substructure 4. Substructure 5. Substructure 6. Substru	3. Circulating Water System							
a. Substructure b. Superstructure c. Steal d. Dredging 2. Dredging 3. Substance of Grebay 4. Saal well 5. Discharge flume 6. Outfall 1. Travaling screen 2. Screen wash piping 1. Travaling screen 3. Screen wash piping 6. Circulating water pumps 1. Tumps 2. Screen wash piping D. Circulating water piping D. Circulation water piping D. Circulation water piping D. Circulation water piping D. Circulation water piping D. Circulation D	A. Structures							
b. Superstructure c. Steal d. Hiscellamenus l. Dredging 3. Dredging 3. Dredging 3. Dredging 3. Dredging 3. Dredging 3. Dredging 3. Dredging 3. Dredging 3. Dredging 3. Dredging 4. Saal well 5. Discharge flume 6. Outfall 8. Drib house equipment 1. Traveling screens 2. Screen wash pumps 4. Chlorination equipment 5. Chlorina handling 0. Circulating water piping 1. Tumps 2. Shoon 2. Sorten wash pumps 1. Tumps 2. Shoon 2. Sorten wash pumps 1. Tumps 2. Shoon 2. Sorten wash pumps 1. Tumps 2. Shoon 2. Sorten wash pumps 2. Shoon 2. Sorten wash pumps 2. Shoon 2. Sorten wash pumps 2. Shoon 2. Sorten wash pumps 2. Shoon 2. Sorten wash pumps 2. Shoon 2. Sorten wash pumps 2. Shoon 2. Sorten wash pumps 2. Shoon 2. Sorten wash pumps 2. Shoon 2. Sorten wash pumps 2. Shoon 2. Sorten wash pumps 2. Shoon 2. Sorten wash pumps 2. Shoon 2. Sorten wash pumps 2. Shoon 2. Dredging 2. Sorten wash pumps 2. Shoon 2. Dredging 2. Sorten wash pumps 2. Shoon 2. Dredging 2. Sorten wash pumps 2. Shoon 2. Dredging 2. Sorten wash pumps 2. Shoon 2. Dredging 2. Sorten wash pumps 2. Shoon 2. Dredging 2. Sorten wash pumps 2. Shoon 2. Shoon 2. Sorten wash pumps 2. Shoon 2. Sorten wash pumps 2. Shoon	The state of the s							
C. Steal d. Miscellaneous 2. Dredging 3. Instable files or forebay 3. Instable files 6. Outfail B. Orth house equipment (erected) 1. Traveling screens 2. Sereen wash pumps 3. Screen wash pings 4. Childrian files equipment 6. Outfail B. Orth house equipment 6. Outfail B. Ortholation equipment 6. Outfail B. Ortholation equipment 6. Outfail B. Ortholation equipment 6. Outfail B. Ortholation equipment 6. Outfail B. Ortholation equipment 6. Outfail B. Ortholation equipment 6. Outfail B. Ortholation equipment 6. Outfail B. Ortholation equipment 6. Outfail B. Ortholation equipment 6. Outfail B. Outfail B. Ortholation equipment 6. Outfail B. Ortholation equipment 6. Outfail B. Ortholation equipment 6. Outfail B. Ortholation equipment 6. Outfail B. Ortholation equipment 6. Outfail B. Outfail B. Ortholation equipment 6. Outfail B. Outfail B. Ortholation equipment 6. Outfail B. Outfail B. Ortholation equipment 6. Outfail B. Ou								
d. Hisealianeous 2. Dredging 3. Intake flume or forebay 4. Sael wall 5. Discharge flume 8. Office house quotinent (erected) 8. Office house quotinent (erected) 9. Office house quotinent (erected) 1. Traveling screens 2. Soreen wash piping 9. Circulating water piping 9. Circulating water piping 9. Circulating water piping 9. Circulating water piping 1. Experiment (erected) 2. Morors 2. Morors 2. Morors 2. Morors 3. Erection 2. Soreen wash piping 1. From the first piping 1. Circulating water piping 9. Circulating water piping 1. Circulating water piping 1. Circulating water piping 1. Circulating water piping 1. Circulating water piping 1. Circulating water piping 1. Circulating water piping 1. Circulating water piping 2. Morors 2. Morors 3. Erection 2. Morors 3. Erection 2. Morors 3. Erection 2. Solo 292,000 294,								
2. Dredging 3. Intake flume of forebay 4. Seal well 5. Discharge flume 6. Outfall 8. Drib house equipment (erected) 1. Discharge flume 6. Outfall 9. Circulating water pumps 1. Circulating water piping 0. Circulating water piping 1. Fumps 2. Motors 3. Motors 4. Motor		C(0.000	£50 000		455 000		*** ***	
3. Intake flume or forebay 4. Seal well 5. Discharge flume 8. Outfall 8. Cut Discharge flume 1. Street weak pumps 2. Street weak piping 9. Circulating water piping 1. Circulating water piping 1. Circulating water piping 1. Circulating water piping 1. Circulating water piping 1. Circulating water piping 1. Circulating water piping 1. Circulating water piping 1. Circulating water piping 1. Circulating water piping 1. Circulating water piping 1. Piping 1. Circulating water piping 1. Circulating water piping 1. Circulating water piping 1. Circulating water piping 1. Circulating water piping 1. Circulating water piping 1. Circulating water piping 1. Circulating water piping 1. Circulating water piping 1. Circulating water piping 1. Circulating water piping 1. Circulating water piping 1. Circulating water piping 1. Circulating water piping 1. Circulating water piping 1. Circulating water piping 2. Circulating water piping 2. Circulating water piping 2. Circulating water piping 2. Circulating water piping 2. Circulating water piping 2. Circulating water piping 2. Circulating water piping 2. Circulating water piping 2. Circulating water piping 2. Circulating water piping 2. Circulating water piping 2. Circulating water piping 2. Circulating water piping 2. Circulation		649,000	652,000	653,000	635,000	659,000	665,000	6/8,00
4. Seal well 5. Discharge flume 6. Outfall 8. Orth house equipment (erected) 1. Traveling screems 2. Screen west pumps 3. Screen west pumps 4. Chlorination equipment 5. Chlorina handling U. Circulating water piping D. Circulating water piping 1. Fumps 2. Motors 2. Motors 2. Motors 2. Motors 2. Motors 2. Motors 2. Motors 2. Motors 3. Erection 2. Screetion					1			
6. Outfall B. Grith house squipment (erected) 1. Traveling screens 2. Screen wash pumps 3. Screen wash piping 4. Chiorination equipment 5. Chiorination squipment 5. Chiorination squipment 6. Circulating water piping D. Circula					1			
B. Orth house aguipment (eracted) 1. Traveling screen 2. Screen wash piping 4. Chlorination equipment 5. Chlorine handling 0. Circulating water piping 625,000 629,000 631,000 635,000 641,000 652,000 674,000 6	5. Discharge flume				4			
1. Traveling screens 2. Screen wash piping 3. Screen wash piping 4. Chlorination equipment 5. Chlorination equipment 5. Chlorination equipment 5. Chlorination equipment 6. Chlorination equipment 7. Chlorination equipment 7. Chlorination equipment 8. Chlorination equipment 8. Chlorination equipment 8. Chlorination equipment 8. Chlorination equipment 8. Chlorination equipment 8. Chlorination equipment 8. Chlorination equipment 8. Chlorination equipment 8. Chlorination equipment 8. Chlorination equipment 8. Chlorination equipment 8. Chlorination equipment 8. Chlorination equipment 8. Chlorination equipment 8. Chlorination equipment 8. Chlorination equipment 8. Chlorination equipment 8. Chlorination 8. Chlorination equipment 9. Chlorination equipment 9. Chlorination equipment 9. Chlorination equipment 9. Chlorination equipment 9. Chlorination equipment 9. Chlorination equipment 9. Chlorination equipment 9. Chlorination equipment 9. Chlorination equipment 9. Chlorination equipment 9. Chlorination equipment 9. Chlorination equipment 9. Chlorination equipment 9. Chlorination equipment 9. Chlorination equipment 9. Chlorination equipment 9. Chlorination equipment 9. Chlorination equipment 9. Chlorination equipment 9. Chlorination 9. Chlorination equipment 9. Chlorination equipment 9. Chlorination equipment 9. Chlorination equipment 9. Chlorination equipment					4			
2. Sorean wash pumps 3. Screen wash piping 4. Chlorination equipment 5. Chlorine handling C. Circulating water piping D. Circulating water piping 1. Fumps 2. Motors 2. Motors 2. Motors 3. Erection 2. Solo 24,000 2. Motors 3. Erection 2. Solo 24,000 2. Motors 3. Erection 2. Solo 24,000 2. Motors 3. Erection 2. Solo 24,000 2. Motors 3. Erection 2. Solo 24,000 2. Motors 3. Erection 2. Solo 24,000 2. Motors 3. Erection 2. Solo 24,000 2. Motors 3. Erection 2. Solo 24,000 2. Motors 3. Erection 2. Solo 24,000 2. Motors 3. Erection 2. Solo 24,000 2. Solo 24,000 2. Election 2. Dataset Heaters A. L-F closed heaters 3. Erection 2. C. Dataset Heaters A. L-F closed heaters 3. Erection 2. Dataset Heaters A. L-F closed heaters 3. Erection 2. Dataset Heaters A. L-F closed heaters 3. Erection 2. Dataset Heaters A. L-F closed heaters 2. Dataset Heaters A. L-F closed heaters 2. Solo 24,500 2. Solo 24,500 2. Solo 38,500 2. Solo	B. Crib house equipment (erected)				1			
3. Screen wash piping 4. Chiorinattion equipment 5. Chlorinatthon equipment 5. Chlorinatthon equipment 6. Circulating water piping D. Circulating water piping D. Circulating water piping 1. Fumps 2. Motors 3. Erection 23,800 292,000 24,000 24,100 24,200 24,200 24,200 24,500 24,500 24,500 24,500 24,500 24,500 24,500 24,500 24,500 24,500 24,500 24,500 24,500 24,500 24,500 24,500 25,500 26,500 27,700 20. Insulation 1. Closed heaters 205,000 199,600 131,500 129,200 127,300 127,300 127,300 127,300 127,300 127,300 127,300 127,300 127,300 127,300 127,300 127,300 127,300 127,000 128,000 128,								
4. Chlorination equipment 5. Chlorine handling U. Circulating water piping D. Circulating water pumps 1. Pumps 2. Motors 2. Motors 2. Motors 3. Erection 2.3,800 2. Motors 3. Erection 2.3,800 2. Motors 3. Erection 2.3,800 2. Motors 3. Erection 2.3,800 2. Motors 3. Erection 2.3,800 2. Motors 3. Erection 2.3,800 2. Motors 3. Erection 2.3,800 2. Motors 3. Erection 2.3,800 2. Motors 3. Erection 2. Motors 3. Erection 2. Motors 3. Erection 2. Motors 3. Erection 2. Motors 3. Erection 2. Motors 3. Erection 2. Motors 3. Erection 2. Motors 3. Erection 2. Motors 3. Erection 2. Motors 3. Erection 2. Motors 3. Erection 2. Motors 3. Erection 2. Motors 3. Erection 2. Dearwaring heater 2. Erection 2. Co. Dearwaring heater 2. Erection 2. Dearwaring heater 2. Erection 2. Dearwaring heater 2. Erection 2. Dearwaring heater 2. Erection 2. Erect		131,000	132,000	132,000	133,000	134,000	136,000	140,00
5. Chlorine handling C. Circulating water piping D. Circulating water piping D. Circulating water pumps 1. Pumps 2. Notors 1. Statetion 2. Notors 3. Exection 2. Notors 3. Exection 2. Statetion 2. Dealerstating heater 2. Dealerstating heater 2. Dealerstating heater 2. Dealerstating heater 2. Dealerstating heater 2. Dealerstating heater 2. Dealerstating heater 2. Dealerstating heater 2. Dealerstating heater 2. Dealerstating heater 2. Dealerstating heater 2. Dealerstating heater 2. Dealerstating heater 2. Dealerstating heater 2. Dealerstating heater 2. Dealerstating heater 2. Dealerstating heater 2. Dealerstating heaters 2. Statetural work 2. Por closed heaters 2. Statetural work 2. Por closed heaters 2. Statetural work 2. Por dealerstating 2. Statetural work 2. Por dealerstating 2. Statetural work 2. Por dealerstating 2. Statetural work 2. Por dealerstating 2. Statetural work 3. Statetural work 3. Statetural work 3. Statetural work 3. Statetural work 3. Statetural work 3. Statetural work 3. Portice of the state place 3. Statetural work 3. Statetura					[
C. Circulating water piping D. Circulating water pumps 1. Pumps 2. Motors 1. Pumps 2. Motors 1. Pumps 2. Motors 1. Pumps 2. Motors 1. Pumps 2. Motors 1. Pumps 2. Motors 1. Pumps 2. Motors 1. Pumps 2. Motors 1. Pumps 2. Motors 1. Pumps 2. Motors 1. Pumps 2. Motors 1. Pumps 2. Motors 1. Pumps 2. Motors 1. Pumps 2. Motors 1. Pumps 2. Motors 1. Pumps 2. Motors 2. Motors 1. Pumps 2. Motor					į			
D. Circulating water pumps 1. Pumps 2. Motors 1. Pumps 2. Motors 1. Expans 2. Motors 1. Expans 2. Motors 1. Expans 2. Motors 1. Expans 2. Motors 3. Exection 2. Jobo 2. Motors 3. Exection 2. Jobo 2. Motors 3. Exection 2. Jobo 2. Motors 3. Exection 3. Expans	Circulating water pining	625,000	629,000	631,000	635,000	641,000	652,000	674-00
1. Fumps	D. Circulating water pumps				1	•	,	*,
3. Erection 23,800 24,000 24,100 24,200 24,500 24,900 25,900 4. Pend Water Heaters A. L-P closed heaters 396,000 239,500 112,500 111,000 54,500 56,500 102,500 B. R-P closed heaters 396,000 239,500 125,200 127,300 126,200 102,500 D. Insulation 1. Closed heaters 12,600 9,000 6,700 4,000 1,300 1.00,000 1.000 1.000 1.000 9,600 9,600 9,400 9,300 1.000		288,000				304,000	315,000	337,00
4. Feed Water Heaters A. L-P closed heaters A. L-P closed heaters 3. K-P closed heaters 3. K-P closed heaters 3. K-P closed heaters 3. K-P closed heaters 3. K-P closed heaters 3. K-P closed heaters 3. K-P closed heaters 3. K-P closed heaters 3. K-P closed heaters 2. Description 1. Closed heaters 1.	2. Motors							
A. L-P closed heaters 36,000 239,500 112,500 111,000 54,500 56,500 102,50	3. Erection	23,800	24,000	24, 100	24,200	24,500	24,900	25,90
A. L-P closed heaters 36,000 239,500 112,500 111,000 54,500 56,500 102,50	4. Feed Water Heaters							
B. H-P closed heaters		177.500	177,500	112,500	111.000	54,500	56,500	
D. Insulation 1. Closed heaters 12,600 9,000 6,700 4,000 1,300 2. Deserators 15,200 14,700 9,800 9,600 9,400 9,300 E. Structural work 1. For closed heaters 28,000 21,000 14,000 7,000 7,000 7,000 2. For deserators 41,600 41,000 29,200 28,300 27,900 27,700 5. Boiler Feed Pumps 299,000 285,000 268,000 260,000 251,000 248,000 242,000 B. Fluid drive 161,000 161,000 161,000 161,000 128,000 128,000 226,000 297,000 D. Brection 30,300 29,000 27,500 26,900 26,000 257,000 257,000 D. Brection for pumps 67,000 5,800 5,400 5,300 5,400 5,300 5,100 5,000 E. Foundation for pumps 67,000 67,000 43,500 26,000 26,000 21,500 21,500 D. Condensate Pumps 67,000 67,000 43,500 44,000 42,000 44,000 B. Motors 40,400 40,300 26,000 26,400 20,600 21,500 C. Frection 6,800 6,800 6,400 6,500 6,200 6,500 Piping and Insulation A. Extraction steam B. Heater vents and drains 268,500 240,000 177,100 163,500 163,500 163,500 199,50 D. Condensate piping 268,500 240,000 177,100 163,500	B. H-P closed heaters	396,000				82,500		102,50
1. Closed heaters 2. Descrators 1. Structural work 1. For closed heaters 2. Structural work 1. For closed heaters 2. For descrators 2. For descrators 4. 1,600 4. 1,000 2. For descrators 3. 1,600 4. 1,000 2. For descrators 3. 1,600 4. 1,000 2. For descrators 3. 1,600 4. 1,000 2. For descrators 3. Folid free deeps 4. Fumps 4. Fumps and base plates 3. Fluid drive 1. Fluid drive 1. For closed heaters 1. Fluid drive 1. Fluid dr		205,000	199,600	131,500	129,200	127,300	126,200	
2. Deaerators					1			
E. Structural work 1. For closed heaters 2. For deaerators 41,600 41,000 29,200 28,500 27,900 27,700 5. Boiler Feed Pumps A. Pumps and base plates 299,000 285,000 269,000 260,000 251,000 248,000 242,000 242,000 243,000 243,000 242,000 243,000 243,000 243,000 243,000 243,000 243,000 243,000 243,000 243,000 243,000 243,000 243,000 243,000 243,000 243,000 243,000 243,000 243,000 253,700 253,700 253,700 253,000 26,000 25,700 253,000 26,000 25,700 253,000 26,000 25,700 253,000 26,000 25,700 25								
1. For closed heaters 28,000 21,000 14,000 7,000 7,000 7.000 7.000 7.000 7.000 27,700 27.700		15,200	14,700	,,,,,,,	,,,,,,,	3,400	9,500	
2. For deserators 41,600 41,000 29,200 28,500 27,900 27,700 5. Boiler Feed Pumps A. Pumps and base plates 299,000 161,000 161,000 161,000 128,00		28,000	21,000	14,000	7,000	7,000		
5. Boiler Feed Pumps A. Pumps and base plates B. Fluid drive C. Motors D. Erection S. Foundation for pumps A. Pumps A. Pumps B. Fluid drive C. Motors D. Erection S. Foundation for pumps A. Pumps A. Pumps A. Pumps B. Fluid drive S. Foundation for pumps A. Pumps A. Pumps A. Pumps A. Pumps A. Pumps A. Pumps A. Pumps A. Pumps A. Pumps A. Pumps B. Motors C. Erection C.							27,700	
A. Pumps and base plates B. Fluid drive 161,000 161,000 161,000 161,000 161,000 161,000 161,000 128,00	5. Roiler Feed Pumps			,				
B. Fluid drive C. Motors C. Motors 375,000 349,000 332,000 317,000 303,000 296,000 297,00 297,00 297,000 27,500 26,900 26,000 25,700 25,300 5,300 5,300 5,300 5,000 44,000 42,000 44,000 44,000 44,000 44,000 44,000 44,000 44,000 44,000 44,000 44,000 44,000 44,000 44,000 44,000 44,000 44,000 45,000	A. Pumps and base plates	299,000	285,000	268,000	260,000	251,000	248,000	242,000
C. Motors D. Erection D. Erection Solution D. Erection Solution D. Erection Solution D. Erection Solution D. Erection Solution D. Erection Solution D. Erection Solution D. Erection Solution D. Erection Solution Solution D. Erection Solution Solution D. Erection Solution D. Erection Solution D. Erection Solution D. Erection Solution D. Condensate Pumps Large piping D. Condensate piping D. Condensate piping D. Erection D. Erection D. Erection D. Erection Solution D. Erection Solution D. Erection		161,000						128,000
E. Foundation for pumps 6,000 5,800 5,400 5,300 5,100 5,000 4,900 6. Condensate Pumps A. Pumps 6,000 67,000 43,500 44,000 42,000 44,000 B. Hotors 40,400 40,300 26,000 6,500 6,200 6,500 C. Exection 6,800 6,800 6,400 6,500 6,200 6,500 7. Piping and Insulation A. Extraction steam B. Heater vents and drains C. Feed water piping 26,8500 240,000 177,100 163,500 163,500 96,600 199,500 D. Condensate piping 1. From condensate pumps through L-P heaters. 2. To deserator and B.F. pump suction E. Main steam 64,300 58,200 58,200 58,200 58,200 58,200 58,200 58,200 8. Demineralizing Equipment and Condensate Storage Tanks 192,300 186,900 181,500 179,000 176,000 175,700 150,30 9. Electrical 192,300 186,900 181,500 179,000 176,000 175,700 150,30 10. Turbine Room Building 89,000 89,000 89,000 89,000 89,000 89,000 89,000 89,000 89,000 19,332,300 19,496,05 7,242,500 7	C. Motors	375,000	349,000	332,000	117,000	303,000	296,000	297,000
6. Condensate Pumps A. Pumps B. Motors C. Exection A. Extraction steam B. Hater vents and drains C. Feed water piping D. Condensate pumps through L-P heaters. 2. To deserator and B.F. pump substitute and Condensate Storage Tanks B. Beatrication B. Beatri								25,30
A. Pumps B. Motors C. Erection A. Extraction steam B. Heater vents and drains C. Peed water piping D. Condensate piping 1. From condensate pumps through L-P heaters. 2. To deserator and B.F. pump suction B. Main steam Condensate Storage Tanks B. Heater Storage Tanks C. Peed water piping D. Condensate Storage Tanks C. Peed water piping D. Condensate Storage Tanks C. Peed water piping D. Condensate Piping D	E. Foundation for pumps	6,000	5,800	5,400	5,300	5,100	5,000	4,90
A. Pumps B. Motors C. Erection A. Strraction steam B. Heater vents and drains C. Feed water piping D. Condensate piping 1. From condensate pumps through L-P heaters. 2. To descrator and B.F. pump suction B. Main steam A. Main steam B. Beatrication B. Heater vents and drains C. Feed water piping D. Condensate Storage Tanks D. Electrical D. Electrical D. Condensate Storage Tanks D. Electrical D. Electrical D. Condensate Storage Tanks D. Electrical D. Electrical D. Turbins Room Building D. Condensate Storage Tanks D. Electrical D.	6. Condensate Pumps				!			
C. Erection 6,800 6,800 6,400 6,500 6,200 6,500 7. Piping and Insulation A. Extraction steam B. Heater vents and drains C. Feed water piping D. Condensate piping 1. From condensate pumps through L-P heaters. 2. To deserator and B.F. pump suction B. Main steam 64,300 58,200 58,200 58,200 58,200 58,200 58,200 58,200 58,200 9. Electrical 192,300 186,900 177,000 179,000 176,000 175,700 150,300 9. Electrical 192,300 186,900 181,500 179,000 176,000 175,700 150,300 10. Turbins Room Building 89,000 89,000 89,000 89,000 89,000 89,000 89,000 89,000 89,000 Total Items 1-10 20,528,350 20,247,350 7,242,500 7,24	A. Pumps							
7. Piping and Insulation A. Extraction steam B. Heater vents and drains C. Feed water piping D. Condensate piping 1. From condensate pumps through L-P heaters. 2. To descrator and B.F. pump suction B. Main steam 64,300 58,200 58,200 58,200 58,200 58,200 58,200 58,200 9. Electrical 192,300 186,900 177,000 173,000 164,000 164,000 162,000 161,000 9. Electrical 192,300 186,900 181,500 179,000 175,700 150,300 10. Turbine Room Building 89,000 89,000 89,000 89,000 89,000 89,000 89,000 89,000 17,242,500 7,242								
A. Extraction steam B. Heater vents and drains C. Feed water piping D. Condensate piping 1. From condensate pumps through L-F heaters. 2. To descrator and B.F. pump succion E. Main steam 6. Pemineralizing Equipment and Condensate Storage Tanks 9. Electrical 192,300 188,000 179,000 177,100 163,500 163,	C. Brection	6,800	6,800	6,400	6,500	6,200	6,500	
B. Heater vents and drains C. Feed water piping D. Condensate piping 1. From condensate pumps through LP heaters. 2. To deserator and B.F. pump sucction B. Main steam 64,300 58,200 58,200 58,200 58,200 58,200 58,200 58,200 8. Demineralizing Equipment and Condensate Storage Tanks 9. Electrical 192,300 186,900 181,500 179,000 176,000 175,700 150,300 Total Items 1-10 20,528,350 20,247,350 19,886,100 19,265,500 7,242,500 7,242,500 7,242,500 7,242,500 7,242,500 7,242,500 7,242,500 7,242,500 7,242,500 7,242,500 566,								
C. Feed water piping D. Condensate piping 1. From condensate pumps through L-P heaters. 2. To deserator and B.F. pump suction B. Main steam 64,300 58,200 58,200 58,200 58,200 58,200 58,200 58,200 S. Benineralizing Equipment and Condensate Storage Tanks 188,000 179,000 173,000 168,000 164,000 162,000 161,00 9. Electrical 192,300 186,900 181,500 179,000 176,000 175,700 150,30 Total Items 1-10 20,528,350 20,247,350 19,886,100 19,706,500 19,332,300 19,496,05 Total Constant Cost 7,242,500 7,24			***	***	1,	44		
D. Condensate piping 1. From condensate pumps through L-F heaters. 2. To descrator and B.F. pump suction E. Main steam 64,300 58,200 58,200 58,200 58,200 58,200 58,200 58,200 8. Demineralizing Equipment and Condensate Storage Tanks 9. Electrical 192,300 186,900 181,500 179,000 176,000 175,700 150,30 O. Turbine Room Building 89,000 89,000 89,000 89,000 89,000 89,000 Total Items 1-10 20,528,350 20,247,350 19,886,100 19,266,500 19,530,800 19,332,300 19,496,05 Total Constant Cost 7,242,500 7,2								
1. From condensate pumps through L-P heaters. 2. To descrator and B.F. pump suction 8. Demineralizing Equipment and Condensate Storage Tanks 9. Electrical 192,300 186,900 179,000 173,000 181,500 179,000 176,000 175,700 180,000 180,300 18		200,500	240,000	1//,100	163,500	163,300	90,000	199,50
through L-P heaters. 2. To descrator and B.F. pump suction E. Main steam 64,300 58,200 58,200 58,200 58,200 58,200 58,200 58,200 8. Demineralizing Equipment snd Condensate Storage Tanks 188,000 179,000 173,000 168,000 164,000 162,000 161,000 9. Electrical 192,300 186,900 181,500 179,000 176,000 175,700 150,300 0. Turbine Room Building 89,000 89,000 89,000 89,000 89,000 89,000 Total Items 1-10 20,528,350 20,247,350 19,886,100 19,706,500 19,530,800 19,332,300 19,496,05 Total Turbine Plant Cost 7,242,500 7,242,500 7,242,500 7,242,500 7,242,500 7,242,500 7,242,500 7,242,500 19,530,800 19,332,300 19,496,05 Total Turbine Plant Cost 7,70,850 27,489,850 27,128,600 26,949,000 26,773,300 26,574,800 26,738,555 1. Piping In Containment Vessel					-			
2. To descrator and B.F. pump sucction B. Main a steam 64,300 58,200 58,200 58,200 58,200 58,200 58,200 58,200 8. Demineralizing Equipment and Condensate Storage Tanks 188,000 179,000 173,000 168,000 164,000 162,000 161,00 9. Electrical 192,300 186,900 181,500 179,000 176,000 175,700 150,300 O. Turbine Room Building 89,000 89,000 89,000 89,000 89,000 89,000 Total Items 1-10 20,528,350 20,247,350 19,886,100 19,206,500 19,332,300 19,332,300 19,496,05 Total Constant Cost 7,242,500 7,242,500 7,242,500 7,242,500 7,242,500 7,242,500 Total Turbine Plant Cost 27,770,850 27,489,850 27,128,600 26,949,000 26,773,300 26,574,880 26,574,880 27,825,500 566,500 566,500 566,500 566,500 566,500 563,500		104,800	104.800	92,200	92,200	78,300	78.300	
pump suction 64,300 58,200 5							•	
8. Demineralizing Equipment and Condensate Storage Tanks 188,000 179,000 173,000 168,000 164,000 162,000 161,000 9. Electrical 192,300 186,900 181,500 179,000 176,000 175,700 150,30 0. Turbine Room Building 89,000 89,000 89,000 89,000 89,000 89,000 89,000 89,000 89,000 Total Items 1-10 20,528,350 20,247,350 19,886,100 19,706,500 19,530,800 19,332,300 19,496,05 Total Constant Cost 7,242,500 7,242,500 7,242,500 7,242,500 7,242,500 7,242,500 7,242,500 19,530,800 19,332,300 19,496,05 20,430,100 19,430,100								
## ## ## ## ## ## ## ## ## ## ## ## ##	E. Main steam	64,300	58,200	58,200	58,200	58,200	58,200	58,20
### and Condensate Storage Tanks	8. Demineralizing Equipment				i			
9. Electrical 192,300 186,900 181,500 179,000 176,000 175,700 150,300 10. Turbine Room Building 89,000 89,000 89,000 89,000 89,000 89,000 89,000 Total Items 1-10 20,528,350 20,247,350 19,886,100 19,706,500 19,530,800 19,332,300 19,496,05 70,242,500 7,242,5	and Condensate Storage Tanks	188,000	179,000	173,000	168,000	164,000	162,000	161,000
0. Turbine Room Building 89,000 89,00				-				
Total Items 1-10 20,528,350 20,247,350 19,886,100 19,706,500 19,530,800 19,332,300 19,496,05 Total Constant Cost 7,242,500 7,242,500 7,242,500 7,242,500 7,242,500 7,242,500 Total Turbine Plant Cost 27,770,850 27,489,850 27,128,600 26,949,000 26,773,300 26,574,800 26,738,55 1. Piping In Containment Vessel 710,000 566,500 566,500 566,500 563,500 563,500 563,500 563,500					;			
Total Constant Cost 7,242,500 7,242,	=		-	•				
Total Turbine Plant Cost 27,770,850 27,489,850 27,128,600 26,949,000 26,773,300 26,574,800 26,738,55 1. Piping In Containment Vessel 710,000 566,500 566,500 566,500 566,500 563,500 563,500								
1. Piping In Containment Vessel 710,000 566,500 566,500 566,500 566,500 563,500 563,500					!			
								26,738,55
Grand Total 28,480,850 28,056,350 27,695,100 27,515,500 27,339,800 27,138,300 27,302,05								
	Grand Total	28,480,850	28,056,350	27,695,100	2/,315,500	27,339,800	2/,138,300	27,302,050

SUMMARY OF COST DATA
1400 PSIA, 887 F THROTTLE STEAM
(100 F SUPERHEAT)
500 MW-INDIRECT CYCLE TURBINE PLANT

_	Heater Arrangement	7	6	3	4	3	2	1
1.	Turbine Generator and Accessories A. Turbine generator unit	12,330,000 540,000	12,330,000 540,000	12,330,000 540,000	12,330,000	12,330,000 540,000	12,330,000 540,000	12,330,000
	B. Turbine generator erection C. Reserve exciter D. Turbine foundation	280,000	280,000	280,000	CONSTANT 280,000		280,000	280,000
2.	Condensers A. Shells and accessories	1,130,000	1,130,000	1,140,000	1,157,000	1,175,000	1,215,000	1,313,000
	B. Dry vacuum pumps	806,000	807,000	814,000	823,000	835,000	866,000	935,000
	C. Tubes D. Steam jet air equipment	19,250	19,250	17,500	17,500	17,500	17,500	33,250
	E. Erection	196,000	196,000	197,000	200,000	202,000	207,000	220,000
	F. Deseration - hot well of	NONE						59,200
	cond. G. L-P heaters in exhaust stack	28,000	28,000	28,000	28,000	14,000	14,000	14,000
3.	A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall B. Crib house equipment (erected) 1. Traveling screens	639,000	639,000	641,000	642,000	645,000	652,000	666,000
	Screen wash pumps Screen wash piping Chlorination equipment	128,000	128,000	128,000	129,000	130,000	132,000	136,000
	5. Chlorine handling C. Circulating water piping D. Circulating pater purpose	607,000	607,000	610,000	612,000	618,000	630,000	652,000
	D. Circulating water pumps 1. Fumps	271,000	272,000	274,000	276,000	282,000	292,000	516,000
	2. Motors	156,000	156,000	157,000	159,000	162,000	168,000	1,81,000
	3. Erection	23,100	23,200	23,200	23,400	23,600	24,000	25,000
4.	Feed Water Heaters					** ***		
	A. L-P closed heaters	171,500 374,000	171,500 228,000	107,000 215,000	108,000 104,000	52,000 80,500	53,500	98,500
	B. H-P closed heaters C. Deaerating heater	133,000	129,200	126,400	124,300	122,900	121,900	
	D. Insulation							
	1. Closed heaters	11,800	8,400	6,400	3,800 9,000	1,200	9,000	
	2. Deaerators E. Structural work	9,900	9,600	9,300	9,000	9,100	3,000	
	1. For closed heaters	28,000	21,000	14,000	7,000	7,000		
	2. For deaerators	29,700	28,500	27,700	27,000	26,600	26,300	
5.	Boiler Feed Pumps							
	A. Pumps and base plates	279,000 161,000	266,000 161,000	252,000 128,000	247,000 128,000	238,000 128,000	236,000 128,000	229,000 128,000
	B. Fluid drive C. Motors	344,000	320,000	307,000	294,000	283,000	277,000	274,000
	D. Erection	28,500	27,300	26,200	25,700	25,000	24,700	24,000
	E. Foundation for pumps	5,600	5,400	5,100	5,000	4,900	4,800	4,700
6.	Condensate Pumps		** **	40 700	(2.000	80 500	/1 000	
	A. Pumps B. Motors	62,500 37,400	62,000 37,200	40,500 24,300	41,000 24,700	39,500 19,300	41,000 20,200	******
	C. Erection	6,300	5,900	5,700	5,800	5,500	5,800	
7.	Piping and Insulation							
	A. Extraction steam			401 700	244 200	10/ 000	120 200	83 200
	B. Heater vents and drains	394,000 217,000	337,000 210,000	294,500 177,100	244,000 163,500	194,000 163,500	138,300 96,600	81,200 199,500
	C. Feed water piping D. Condensate piping	217,000	210,000	177,100	105,500	105,500	30,000	,
	1. From condensate pumps							
	through L-P heaters.	104,800	104,800	92,200	83,100	75,900	75,900	
	2. To deaerator and B.F. pump suction							
	E. Main steam	79,300	73,000	67,000	67,000	67,000	67,000	67,000
8.	Demineralizing Equipment						1/2 00-	160 000
	and Condensate Storage Tanks	175,000	167,000	162,000	158,000	156,000	155,000 168,800	153,000 142,800
9.	Electrical	182,900	177,900	173,300	171,300	168,700		
10.	Turbine Room Building	178,000	178,000	178,000	178,000	178,000	178,000	178,000
	Total Items 1-10	20,166,550	19,884,150	19,618,400	19,436,100	19,299,700	19,195,300	19,280,150 7,242,500
	Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	26,522,650
11	Total Turbine Plant Cost	27,409,050 664,000	27,126,650 595,500	26,860,900 592,500	26,678,600 589,500	26,542,200 589,500	26,437,800 589,500	589,500
41.	Piping In Containment Vessel- Grand Total					·		
		28,073,050	27,722,150	27,453,400	27,263,100	27,131,700	27,027,300	27,112,150

SURMARY OF COST DATA
1400 PSIA, 987 F THROTTLE STEAM
(400 F SUPERHEAT)
500 MM INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	7	6	3	<u> </u>	3	2	1
1. Turbine Generator and Accessories				1	-		
A. Turbine generator unit	12,690,000	12,690,000	12,690,000	12,690,000	12,690,000	12,690,000	12,690,000
B. Turbine generator erection	540,000	540,000	540,000	540,000 — CONSTANT	540,000	540,000	540,000
C. Reserve exciter D. Turbine foundation	280,000	280,000	280,000	CONSTANT	280,000	280,000	280,000
2. Condensers A. Shells and accessories	1,070,000	1,070,000	1,078,000	1,090,000	1,108,000	1,157,000	1,225,000
B. Dry vacuum pumps							
C. Tubes	764,000	765,000	772,000	780,000	789,000	822,000	875,000
D. Steam jet air equipment	19,250	19,250	17,500	17,500	17,500	17,500	33,250
E. Erection	187,000 None	187,000	188,000	191,000	194,000	199,000	209,000
F. Deseration - hot well of cond.	AUNE						55,100
G. L-P heaters in exhaust stack	28,000	28,000	28,000	28,000	14,000	14,000	14,000
A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous	630,000	630,000	632,000	634,000	636,000	642,000	653,000
2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall B. Crib house equipment (erected) 1. Traveling screens							
2. Screen wash pumps 3. Screen wash piping 4. Chlorination equipment 5. Chlorine handling	125,000	125,000	125,000	126,000	127,000	129,000	132,000
C. Circulating water piping D. Circulating water pumps	592,000	592,000	595,000	597,000	603,000	612,000	631,000
1. Pumps	256,000	257,000	259,000	252,000	266,000	276,000	296,000
2. Motors	147,000	147,000	149,000	150,000	153,000	158,000	170,000
3. Erection	22,500	22,500	22,600	22,800	23,000	23,400	24,100
4. Feed Water Heaters A. L-P closed beaters	163,500	163,500	103,000	104,500	50,000	51,500	
B. H-P closed heaters	359,000	219,000	207,000	100,000	78,500		96,500
C. Deserating heater D. Insulation	128,000	124,100	121,800	120,000	118,500	117,800	
1. Closed heaters	11,100	8,000	5,900	3,600	1,100		
2. Deaerators	9,400	9,100	9,000	8,800	8,700	8,700	
E. Structural work							
1. For closed heaters	28,000	21,000	14,000	7,000	7,000	24 900	
2. For deserators	28,100	27,000	26,300	25,800	25,400	24,800	
5. Boiler Feed Pumps	262,000	252,000	240,000	285,000	228,000	225,000	222,000
A. Pumps and base plates B. Fluid drive	161,000	128,000	128,000	128,000	128,000	128,000	128,000
C. Motors	318,000	297,000	284,000	276,000	265,000	261,000	262,000
D. Erection	27,000	26,000	25,000	24,700	24,000	23,800	23,400
E. Foundation for pumps	5,300	5,100	5,000	4,800	4,700	4,600	4,500
6. Condensate Pumps				i			
A. Pumps	58,500	58,000	38,000	89,000	37,500	39,000	
B. Motors	35,000	34,800	22,900	23,300	18,400	19,100	
C. Erection	6,000	5,900	5,700	5,800	5,500	5,800	
7. Piping and Insulation							
A. Extraction steam	394,000	337,000	294,500	244,000	194,000	138,300	81,200
B. Reater vents and drains	217,000	210,000	177,100	156,100	156,100	96,600	199,500
C. Feed water piping D. Condensate piping	227,000	210,000	1,7,100	1,50,100	2,00, 200	,,,,,,,,	2,,,,,,,,
1. From condensate pumps through L-P heaters. 2. To deaerator and B.F.	98,000	98,000	83,100	83,100	75,900	75,900	
pump suction	89,700	89,700	89,700	89,700	89,700	89,700	89,700
3. Demineralizing Equipment	165 000	159 000	154,000	151,000	149,000	148,000	148,000
and Condensate Storage Tanks	165,000	158,000		4 -			
9. Electrical	175,000	170,700	166,900	165,200	162,800	162,900	137,800
O. Turbine Room Building	178,000	178,000	178,000	178,000	178,000	178,000	178,000
Total Items 1-10	20,267,350	19,972,650	19,755,000	19,581,700	19,446,300	19,358,400	19,398,050
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	27,509,850	27,215,150	26,997,500	26,824,200	26,688,800	26,600,900	26,640,550
1. Piping In Containment Vessel	760,500	678,500	678,500	674,500	674,500	674,500	674,500
Grand Total	28,270,350	27,893,650	27,676,000	27,498,700	27,363,300	27,275,400	27,315,050

SUMMARY OF COST DATA
1200 PSIA, 567 F THROTTLE STEAM
(SATURATED STEAM)
500 MWW INDIRECT CYCLE TURBINE PLANT

	Heater Arrangement		5	4	3-	2	1
	e Generator and Accesso	ries					
A. Tur	bine generator unit.	14,530,000	14,530,000	14,530,000	14,530,000	14,530,000	14,530,000
	bine generator erection	560,000	560,000	560,000	\$50,000	560,000	560,000
	erve exciter bine foundation	280,000	280,000	280,000	280,000	280,000	280,000
		200,000	250,000	200,000	100,000	200,000	200,000
2. Conden	sers lls and accessories	٠ ٦		1 /10 000		1 /00 000	
	vacuum pumpa	} 1,400,000	1,402,000	1,410,000	1,450,000	1,490,000	1,610,000
C. Tub		995,000	1,000,000	1,012,000	1,031,000	1,070,000	1,144,000
	am jet air equipment	19,250	19,250	19,250	17,500	17,500	33,250
E. Erec		232,000	233,000	235,000	238,000	246,000	262,000
r. Deac	eration - hot well of	NONE -		,			72,500
	heaters in exhaust star	zk 28,000	28,000	28,000	14,000	14,000	14,000
	ating Water System				'		
	ctures	_					
1. (Crib house						
	1. Substructure	1					
	Superstructure						
	. Steel 1. Miscellaneous			451 000	**** ***	600 000	700 00
	redging	678,000	679,000	681,000	685,000	693,000	709,000
	intake flume or forebay	1			İ		
	Seal well				į		
	Discharge flume				!		
	otfall house equipment (erect	្នត៍			i		
	raveling screens				ř		
	creen wash pumps				1		
	creen wash piping	140,000	141,000	142,000	143,000	145,000	150,000
	hlorination equipment	ì					
	hlorine handling ulating water piping	674,000	676,000	680,000	686,000	700,000	726,000
	ulating water pumps	· · · · · · ·		- · . •			
1. P		337,000	339,000	342,000	\$49,000	362,000	388,000
	otors	193,000	195,000	197,000	200,000	208,000	223,000
3. E	rection	25,800	25,900	26,100	26,300	26,900	28,000
. Feed Wa	ter Heaters						
	closed heaters	256,000	152,500	154,000	71,500	75,000	119,000
	closed heaters rating heater	312,500 231,000	280,500 222,600	136,000 216,200	118,000 210,800	205,600	119,000
D. Insu		32,000	,***	,	1,	,	
	losed heaters	12,700	9,600	5,600	2,400		
	eaerators	17,000	16,400	15,900	15,500	15,300	
	ctural work	21,000	14,000	7,000	7,000		
	or closed heaters or deserators	49,200	47,000	45,200	43,800	43,000	
		,		- 7		· ·	
	Feed Pumps s and base plates	345,000	313,000	297,000	277,000	269,000	257,000
B. Flui		161,000	161,000	161,000	128,000	128,000	128,000
C. Moto		363,000	346,000	322,000	304,000	290,000	287,000 24,400
D. Erec		31,100 7,300	28,800 6,700	27,500 6,400	25,900 6,000	25,300 5,800	5,60
E. Found	dation for pumps	7,500	0,700	0,400	, 0,000	3,500	•,••
. Condens		** ***	** ***	63.000	50.000	53,000	
A. Pump		99,000 67,200	66,500 36,900	67,000 37,500	50,000 24,100	53,000 25,300	
B. Motor		8,500	7,800	7,900	7,300	7,600	
		••••	•	ŕ			
	and Insulation action steam	٦					70.00
	er vents and drains	332,000	295,000	242,000	210,000	133,500	79,00
	water piping	225,100	222,500	147,300	147,300	89,100	172,60
	ensate piping						
	rom condensate pumps	161,300	113,300	113,300	103,200	103,200	
	hrough L-P heaters.	101,300	113,300	113,500	203,200	105,200	
	o deaerator and B.F. ump suction	. J			İ		
E. Main		28,500	28,500	25,600	25,600	25,600	25,60
	alizing Equipment						
	lensate Storage Tanks	229,000	216,000	205,000	196,000	190,000	188,000
and Cont	_	199,600	191,800	187,200	181,800	180,800	154,600
		178,000	178,000	178,000	178,000	178,000	178,00
. Electri	Doom Buillde-		1/0.000				
. Electri . Turbine	Room Building			22.746.050	22.543.000	22,385.500	22,340.33
. Electri . Turbine Total I	tems 1-10	23,427,050	23,062,550	22,746,950	22,543,000 7,242,500	22,385,500 7,242,500	
. Electric . Turbine Total In Total Co	tems 1-10 Donstant Cost	23,427,050 7,242,500	23,062,550 7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
. Electricoloria de la Contrad	tems 1-10	23,427,050	23,062,550				22,348,550 7,242,500 29,591,050 443,000

SUMMARY OF COST DATA
1200 PSIA, 667 F THROTTLE STEAM
(100 F SUPERHEAT)
500 MW INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	- 6	5	4	3	2	1
. Turbine Generator and Accessories			·	- 		
A. Turbine generator unit	13,050,000	13,050,000	13,050,000	13 050 000	13,050,000	13,050,00
B. Turbine generator erection	560,000	560,000	560,000	560,000	560,000	560,00
C. Reserve exciter D. Turbine foundation	4	*** ***		ONSTANT -		
	280,000	280,000	280,000	280,000	280,000	280,00
Condensers						
A. Shells and accessories B. Dry vacuum pumps	1,320,000	1,323,000	1,342,000	1,370,000	1,407,000	1,490,00
C. Tubes	940,000	945,000	957,000	1		
D. Steam jet sir equipment	19,250	19,250	19,250	975,000 17,500	999,000 17,500	1,045,00 33,25
E. Erection	220,000	221,000	225,000	227,000	232,000	245,00
P. Deseration - hot well of	NONE -					67,10
cond. G. L-P heaters in exhaust stack	20 000	20 000	88 888	1/ 000		
	28,000	28,000	28,000	14,000	14,000	14,00
Circulating Water System A. Structures						
1. Crib house						
a. Substructure						
b. Superstructure						
c. Steel						
d. Miscellaneous 2. Dredging	666,000	669 000	670 000	674 000	£00' 000	
3. Intake flume or forebay	000,000	668,000	670,000	674,000	680,000	693,0
4. Seal well				İ		
5. Discharge flume				j		
6. Outfall				1		
B. Crib house equipment (erected) 1. Traveling screens				gi -		
2. Screen wash pumps						
3. Screen wash piping	137,000	137,000	138,000	139,000	141,000	145,0
4. Chlorination equipment			-		•	•
5. Chlorine handling	CER 000	252 AAA	*** ***		4-4	
C. Circulating water piping D. Circulating water pumps	653,000	656,000	660,000	666,000	676,000	699,0
1. Pumps	317,000	319,000	323,000	329,000	340,000	362,0
2. Motors	182,000	183,000	185,000	189,000	195,000	208,0
3. Erection	25,000	25,100	25,300	25,500	26,000	26,9
Feed Water Heaters						
A. L-P closed heaters	228,500	139,000	140,000	66,000	69,000	
B. H-P closed heaters	287,000	259,000	125,000	110,000		119,00
C. Deserating heater	215,000	208,800	203,800	199,800	132,400	
D. Insulation 1. Closed heaters	11,200	9,300	5,100	2,200		
2. Deserators	15,800	15,400	15,000	14,700	9,800	
E. Structural work	•	-	=		**	
1. For closed heaters	21,000	14,000	7,000	7,000	<u></u>	
2. For deaerators	45,000	43,400	42,000	41,000	29,500	
Boiler Feed Pumps						
A. Pumps and base places	304,000	279,000	268,000	252,000	245,000	236,00
B. Fluid drive C. Motors	161/,000 362,000	161,000 346,000	161,000 325,000	128,000 308,000	128,000	128,00
D. Erection	28,000	26,000	25,200	24,000	293,000 23,300	292,00 22,80
E. Foundation for pumps	6,500	6,100	5,800	5,500	5,400	5,20
Condensate Pumps	·	•			-,	-,-
A. Pumps	87,500	59,000	60,500	46,000	48,000	
B. Motors	60,100	33,500	34,000	22,300	23,200	
C. Brection	7,700	7,100	7,200	6,700	7,000	
Piping and Insulation						
A. Extraction steam	332,000	295,000	242.000	110 000	122 500	70.00
B. Heater vents and drains		•	242,000	210,000	133,500	79,00
G. Feed water piping	241,800	241,800	153,900	153,900	96,100	186,30
0. Condensate piping 1. From condensate pumps				i		
through L-P heaters.	108,900	92,200	92,200	92,500	92,500	
2. To deaerator and B.P.	-	-	Ť			
pump suction				i		
. Main steam	32,700	32,700	18,000	18,000	18,000	18,00
emineralizing Equipment						
ind Condensate Storage Tanks	203,000	199,000	185,000	180,000	175,000	173,00
Blectrical	196,000	188,700	184,800	180,200	178,700	152,40
furbine Room Building	89,000	89,000	89,000	89,000	89,000	89,00
	21,435,950	21,153,350	20,852,050	20,672,800	20,413,900	20,418,95
				, 4, 4,000	,, ,,,,,	,,
fotal Items 1-10			7,242,500	7.242.500	7,242.500	7,242.50
fotal Items 1-10 Fotal Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	,
fotal Items 1-10			7,242,500 28,094,550 418,500	7,242,500 27,915,300 418,500	7,242,500 27,656,400 418,500	7,242,50 27,661,45 418,00

SUMMARY OF COST DATA
1200 PSIA, 767 F THROTTLE STEAM
(200 F SUPERHEAT)
500 MWW INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories	W					
A. Turbine generator unit	12,330,000	12,330,000 500,000	12,330,000 500,000	12,330,000	12,330,000	12,330,000
B. Turbine generator erection C. Reserve exciter	500,000	300,000		500,000	500,000	500,000
D. Turbine foundation	230,000	230,000	230,000	230,000	230,000	230,000
C. Condensers						
A. Shells and accessories	1,243,000	1,250,000	1,275,000	1,300,000	1,340,000	1,418,000
B. Dry vacuum pumps				1' '		
D. Steam jet air equipment	884,000 19,250	895,000 19,250	906,000 19,250	929,000 17,500	956,000 17,500	1,008,000 33,250
E. Brection	211,000	213,000	215,000	219,000	225,000	234,000
F. Deseration - hot well of	none —		-	+		63,000
cond. G. L-P heaters in exhaust stack	28,000	28,000	28,000	14,000	14,000	14,000
. Circulating Water System	-		•		•	·
A. Structures				Į.		
1. Crib house a. Substructure						
b. Superstructure				İ		
c. Steel	655,000	657,000	660,000	664,000	670,000	680,000
d. Miscellaneous						
2. Dredging 3. Intake flume or forebay						
4. Seal well				i		
5. Discharge flume						
6. Outfall B. Crib house equipment (erected)						
1. Traveling screens						
2. Screen wash pumps						1/1 000
3. Screen wash piping	133,000	134,000	135,000	136,000	138,000	141,000
4. Chlorination equipment 5. Chlorine handling				i		
C. Circulating water piping	635,000	638,000	643,000	650,000	660,000	678,000
D. Circulating water pumps	298,000	302,000	306,000	313,000	323,000	341,000
1. Pumps 2. Motors	171,000	173,000	176,000	180,000	185,000	196,000
3. Erection	242,000	244,000	246,000	249,000	253,000	260,000
. Feed Water Heaters						
A. L-P closed heaters	213,000	130,000	131,000	62,500	65,000	106 500
B. H-P closed heaters C. Deaerating heater	267,000 205,000	244,000 199,800	118,000 131,700	105,000	127,300	106,500
D. Insulation	203,000	1,,,,,,,,,,,	252,700	127,200	,,,,,,,	
1. Closed heaters	10,400	7,800	4,800	2,000		
2. Descrators	15,100	14,900	9,800	9,600	9,400	
B. Structural work For closed heaters 	21,000	14,000	7,000	7,000		
For deserators	42,400	41,000	29,300	28,500	27,900	
Boiler Feed Pumps				1		
A. Pumps and base places B. Fluid drive	279,000 161,000	257,000 161,000	249,000 128,000	235,000 128,000	231,000 128,000	223,000 128,000
C. Motors	326,000	314,000	296,000	282,000	273,000	271,000
D. Erection	26,000	24,500	23,700	22,700	22,300	21,800
E. Foundation for pumps	6,000	5,600	5,500	5,200	5,100	5,000
Condensate Pumps	70.000	F.E. E.O.O.	E4 000	. 43 500	45,000	
A. Pumps B. Motors	79,000 54,900	55,500 31,100	56,000 31,500	43,500 21,100	21,900	
C. Erection	7,100	6,600	6,700	6,400	6,600	
Piping and Insulation				i		
A. Extraction steam	332,000	292,500	242,000	210,000	133,500	79,000
B. Heater vents and drains	241,800	194,800	153,900	153,900	96,100	186,300
C. Feed water piping D. Condensate piping	241,000	194,000	133,300	255,500	50,200	200,000
1. From condensate pumps						
through L-P heaters.	108,900	92,200	92,200	92,500	92,500	
2. To deaerator and B.F.				i		
pump suction B. Main steam	61,800	61,800	55,300	51,100	51,100	51,100
Demineralizing Equipment				:		
and Condensate Storage Tanks	188,000	180,000	173,000	168,000	165,000	163,000
Electrical	185,300	179,400	176,200	172,500	171,900	145,300
Turbine Room Building						
Total Items 1-10	20,409,950	20,120,750	19,789,850	19,667,200	19,514,100	19,506,250
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	27,652,450	27,363,250	27,032,350	26,909,700	26,756,600 493,000	493,000
Piping In Containment Vessel	547,000 28.199.450	525,000 27,888,250	499,500 27,531,850	493,000 27,402,700	27,249,600	27,241,750
Grand Total	28,199,450	27,888,250	27,531,850	47,402,700	27,249,500	2/,241,/5

SUMMARY OF COST DATA
1200 FSIA, 867 F THROTTLE STEAM
(300 F SUPERHEAT)
500 MW= INDIRECT CYCLE TURBINE PLANT

	300 IME 1	NDIRECT CYCLE	TORDING PLANT			
Reater Arrangement	- 6	3	4	3	2	1
1. Turbine Generator and Accessories A. Turbine generator unit B. Turbine generator erection	12,330,000 540,000	12,330,000 540,000	12,330,000 540,000	12,330,000 540,000	12,330,000 540,000	12,330,000 540,000
G. Reserve exciter D. Turbine foundation	280,000	280,000	280,000	280,000	280,000	280,000
2. Condensers A. Shells and accessories B. Dry vacuum pumps	1,163,000	1,180,000	1,195,000	1,210,000	1,250,000	1,314,000
C. Tubes	830,000	840,000	850,000	864,000	895,00	942,000
D. Steam jet air equipment	19,250	19,250	19,250	17,500	17,500	33,500
E. Erection F. Descration - hot well of	201,000 NONE	203,000	205,000	207,000	211,000	222,000 59,200
cond. G. L-P heaters in exhaust stack	28,000	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System A. Structures I. Crib house a. Substructure b. Superstructure c. Steel d- Miscellaneous 2. Dredging	644,000	646,000	648,000	652,000	657,000	667,000
3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall B. Crib house equipment (erected) 1. Traveling screens 2. Screen wash pumps	129,000	130,000	131,000	132,000	134,000	137,000
3. Screen wash piping 4. Chlorination equipment 5. Chlorine handling	,		-2-,	 - -		25,,000
C. Circulating water piping D. Circulating water pumps	616,000	619,000	623,000	629,000	638,000	656,000
1. Pumps	280,000	283,000	286,000	292,000	302,000	318,000
2. Motors	161,000	162,000	164,000	168,000	173,000	183,000
3. Brection . Feed Water Heaters	23,500	23,700	23,800	24,000	24,400	25,100
A. L-P closed heaters	199,500	122,500	123,500	59,000	61,000	
B. H-P closed heaters C. Deserating heater	247,500 133,000	231,000 129,400	112,500 126,600	100,500 124,100	122,800	102,500
D. Insulation 1. Closed heaters	9,500 9,900	7,500 9,600	4,500 9,300	1,900 9,100	9,000	
2. Deserators E. Structural work	,,,,,,,	,,,,,,,	9,300	7,100	,,000	
1. For closed heaters	21,000 30,000	14,000	7,000	7,000 27,000	26 500	
2. For deserators . Boiler Feed Pumps	30,000	28,500	27,700	27,000	26,500	
A. Pumps and base plates	260,000	242,000	233,000	221,000	219,000	212,000
B. Fluid drive	128,000	128,000	128,000	128,000	128,000	128,000
C. Motors D. Brection	298,000	288,000	274,000	262,000	253,000	252,000
E. Foundation for pumps	24,600 5,700	23,200 5,300	22,500 5,200	21,600 4,900	21,400 4,900	20,900 4,800
. Condensate Pumps	2,,,,,	.,	-,	,,,,,,	.,,,,	,,,,,,
A. Pumps	73,500	51,500	52,000	40,200	42,000	
B. Motors C. Erection	50,800 6,600	29,000 6,200	29,400 6,300	21,800 6,000	20,500 6,200	
Piping and Insulation	0,000	0,200	0,500	0,000	0,200	
A. Extraction steam	331,000	283,500	242,000	184,000	125,900	79,000
B. Heater vents and drains C. Feed water piping	194,800	194,800	153,900	153,900	96,100	186,300
D. Condensate piping 1. From condensate pumps through L-P heaters.	108,900	92,200	92,200	85,800	83,400	
2. To descrator and B.F. pump suction						
E. Main steam Demineralizing Equipment	70,800	70,800	70,800	70,800	70,800	70,800
and Condensate Storage Tanks	175,000	169,000	162,000	158,000	156,000	155,000
Electrical	176,800	171,400	168,800	165,900	165,100	136,200
Turbine Room Building	178,000	178,000	178,000	178,000	178,000	178,000
Total Items 1-10	19,977,650 7,242,500	19,759,350	19,552,250	19,390,000	19,255,500	19,246,300
Total Constant Cost Total Turbine Plant Cost	27,220,150	7,242,500 27,001,850	7,242,500 26,794,750	7,242,500 26,632,500	7,242,500 26,498,000	7,242,500 26,488,800
Piping In Containment Vessel	576,500	576,500	572,500	572,500	572,500	572,500
Grand Total	27,796,650	27,578,350	27,367,250	27,205,000	27,070,500	27,061,300

SUMMARY OF COST DATA
1200 PSIA, 967 F TRROTTLE STEAM
(400 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	I.
1. Turbine Generator and Accessories A. Turbine generator unit B. Turbine generator erection	12,690,000 540,000	12,690,000 540,000	12,690,000 540,000	12,690,000 540,000	12,690,000 540,000	12,690,000 540,000
C. Reserve exciter D. Turbine foundation	280,000	280,000	280,000	280,000	280,000	280,000
2. Condensers A. Shells and accessories B. Dry vacuum pumps	1,100,000	1,113,000	1,130,000	1,158,000	1,180,000	1,245,000
C. Tubes	782,000	790,000	800,000	820,000	845,000	840,000
D. Steam jet air equipment	19,250	19,250	19,250	17,500 199,000	17,500 203,000	17,500 212,000
E. Erection F. Deaeration - hot well of	193,000 NONE	194,000	195,000	199,000		> 56,000
cond. G. L-P heaters in exhaust stack	28,000	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall B. Crib house equipment (erected)	634,000	636,000	638,000	642,000	647,000	656,000
1. Traveling screens 2. Screen wash pumps 3. Screen wash piping 4. Chlorination equipment	126,000	127,000	128,000	128,000	130,000	133,000
5. Chlorine handling C. Circulating water piping D. Circulating water pumps	598,000	602,000	607,000	611,000	621,000	636,000
1. Pumps	263,000	266,000	270,000	275,000	284,000	300,000 172,000
2. Motors	151,000	153,000	155,000 23,100	158,000 23,300	163,000 23,700	24,300
3. Erection	22,800	22,900	23,100	25,500	20,700	,
4. Feed Water Heaters	187,000	117,000	118,000	56,500	58,500	
A. L-P closed heaters B. H-P closed heaters	239,000	221,000	108,000	96,500		99,500
C. Descrating heater D. Insulation	128,000	124,500	121,900	119,800	118,700	
1. Closed heaters 2. Deaerators	8,900 9,500	6,900 9,200	4,200 9,000	1,800 8,800	8,700	
E. Structural work	21,000	14,000	7,000	7,000		
 Por closed heaters For deserators 	28,100	27,100	26,300	25,800	25,400	
5. Boiler Feed Pumps	244,000	229,000	221,000	212,000	208,000	203,000
A. Pumps and base plates B. Fluid drive	128,000	128,000	128,000	128,000	128,000	128,000
C. Motors	277,000	268,000	255,000	243,000	237,000	236,000
D. Erection	23,400	22,200	21,600	20,900	20,600 4,700	20,200 4,600
E. Foundation for pumps	5,400	5,100	4,900	4,700	4,700	4,000
6. Condensate Pumps	46.000	40 500	48,500	42,000	39,500	
A. Pumps	68,000 41,400	48,500 27,200	27,600	18,800	19,500	
B. Motors C. Erection	6,100	5,800	5,900	5,700	5,900	
7. Piping and Insulation A. Extraction steam	327,500	283,000	242,000	184,000	125,900	79,000
B. Heater vents and drains C. Feed water piping D. Condensate piping	194,800	194,800	153,900	153,900	96,100	186,300
1. From condensate pumps through L-F heaters. 2. To deaerator and B.F. pump suction	102,000	85,500	83,400	83,400	83,400	88 800
E. Main steam	82,800	82,800	82,800	82,800	82,800	82,800
8. Demineralizing Equipment and Condensate Storage Tanks	166,000	159,000	155,000	151,000	149,000	148,000
9. Electrical	168,400	164,800	162,700	159,700	159,600	133,500
10. Turbine Room Building	178,000	178,000	178,000	178,000	178,000	178,000
Total Items 1-10	20,061,350	19,862,550	19,668,050	19,539,900	19,387,500	19,313,900
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	27,303,850	27,105,050	26,910,550	26,782,400	26,630,000	26,556,400 602,500
11. Piping In Containment Vessel	606,500	606,500	603,500	603,500	603,500	27,158,900
Grand Total	27,910,350	27,711,550	27,514,050	27,385,900	27,233,500	27,130,900

SUMMARY OF COST DATA 1000 PSIA, 545 F THROTTLE STEAM (SATURATED STEAM) 500 MMe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessorie	14			 		
A. Turbine generator unit	14,530,000	14,530,000	14,530,000	14,530,000	14,530,000	14,530,000
B. Turbine generator erection	560,000	560,000	560,000	560,000	560,000	560,000
C. Reserve exciter	· <			DISTANT		
D. Turbine foundation	280,000	280,000	280,000	280,000	280,000	280,000
2. Condensers						
A. Shells and accessories	1,455,000	1,475,000	1,500,000	1 520 000	1 574 000	1 600 000
B. Dry vacuum pumps	1		•	1,530,000	1,576,000	1,690,000
C. Tubes	1,035,000	1,049,000	1,066,000	1,087,000	1,118,000	1,205,000
D. Steam jet sir equipment	19,250	19,250	19,250	17,500	17,500	31,500
E. Erection	238,000 NONE —	242,000	245,000	249,000	256,000	270,000
F. Deseration - hot well of cond.	- 2004					76,100
G. L-P heaters in exhaust stack	28,000	28,000	28,000	14,000	14,000	14,000
	,	,	20,000	1.,000	,	,
3. Circulating Water System A. Structures	-					
1. Grib house)					
a. Substructure						
b. Superstructure	1					
c. Steel				1		
d. Miscellaneous	686,000	689,000	692,000	697,000	704,000	720,000
2. Dredging	f					•
Intake flume or forebay						
4. Seal well						
5. Discharge flume	.1					
6. Outfall B. Crib house equipment (eracted)	5					
1. Traveling screens	']			É		
2. Screen wash pumps	l					
3. Screen wash piping	143,000	144,000	145,000	146,000	149,000	154,000
4. Chlorination equipment		•	-		-	,
 Chlorine handling — 	J					
C. Circulating water piping	688,000	692,000	698,000	706,000	718,000	745,000
D. Circulating water pumps		255 222	*** ***		222 222	*** ***
1. Pumps	350,000	355,000	360,000	368,000	380,000	406,000
2. Motors 3. Erection	201,000 26,400	204,000 26,500	207,000 26,800	212,000 27,100	218,000 27,600	234,000 28,700
	20,400	20,500	20,000	27,100	27,000	20,700
. Feed Water Heaters						
A. L-P closed heaters	251,000	156,000	158,000	75,000	79,000	
B. H-P closed heaters	290,500	259,000	118,000	104,500	*******	118,000
C. Desersting heater D. Insulation	229,400	221,800	215,000	210,600	209,000	
1. Closed heaters	12,200	9,200	5,300	2,100		
2. Deserators	16,900	16,300	15,800	15,500	15,400	
E. Structural work	20,,,,,	20,000	25,000	25,500	25,400	
1. For closed heaters	21,000	14,000	7,000	7,000		
2. For deserators	48,800	46,800	45,000	43,800	43,400	
. Boiler Feed Pumps						
A. Pumps and base plates	209,000	194,000	180,000	176,000	173,000	165,000
B. Fluid drive	128,000	128,000	128,000	128,000	128,000	128,000
C. Motors	308,000	296,000	275,000	265,000	255,000	252,000
D. Erection	26,900	25,000	24,000	23,000	22,600	21,600
B. Foundation for pumps	7,100	6,600	6,300	6,000	5,900	5,800
. Condensate Pumps						
A. Pumps	100,000	67,500	68,000	51,500	55,500	
B. Motors	59,100	35,500	35,900	24,700	26,100	
C. Erection	8,600	7,900	8,000	7,500	7,900	
Piping and Insulation						
A. Extraction steam	219 000	901 100	226 500	210 000	122 500	71 400
B. Heater vents and drains	318,000	281,500	228,500	210,000	133,500	71,400
C. Feed water piping	198,100	198,100	125,200	125,200	79,500	147,300
D. Condensate piping	1			ļ		
1. From condensate pumps]					
through L-P heaters.	<u>} 161,300</u>	113,300	113,300	103,200	103,200	
2. To deserator and B.F. pump suction						
E. Main steam	35,200	33,900	31,000	28,500	28,500	28,500
	33,400	23,500	31,000	20,300	20,500	20,500
Demineralizing Equipment	40/	21/ 222	600.000	106 000	104.000	100 000
and Condensate Storage Tanks	226,000	214,000	203,000	196,000	194,000	189,000
Electrical	188,700	182,900	179,200	176,300	176,100	149,600
Turbine Room Building	178,000	178,000	178,000	178,000	178,000	178,000
Total Items 1-10	23,261,450	22,979,050	22,704,550	22,581,000	22,461,700	22,398,500
	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Constant Cost				1		
Total Turking Dic-			10 0A7 AKA	29,823,500	29,704,200	29,641,000
Total Turbine Plant Cost	30,503,950	30,221,550	29,947,050		375 000	
Total Turbine Plant Cost Piping In Containment Vessel Grand Total	30,503,950 474,000 30,977,950	30,221,330 414,000 30,635,550	384,000 30,331,050	378,000 30,201,500	375,000 30,079,200	378,000 30,019,000

SUMMARY OF COST DATA
1000 PSIA, 645 F THROTTLE STEAM
(100 F SUPERHEAT)
500 MMe INDIRECT CYCLE TURBINE PLANT

Reater Arrangem	ent	6	55	4	3	2	
1. Turbine Generator and	Accessories						
A. Turbine generator	unit 13	,050,000	13,050,000		3,050,000	13,050,000	13,050,000
B. Turbine generator	erection	560,000	560,000	560,000	560,000	560,000	560,000
C. Reserve exciter D. Turbine foundation	•	280,000	280,000	280,000	280,000	280,000	280,000
2. Condensers							
A. Shells and accessor	ries 🧻 .	270 000	1 200 000	1 205 000	1 430 000	1 460 000	1,563,000
B. Dry vacuum pumps	·	,370,000	1,380,000	1,395,000	1,420,000	1,460,000	
C. Tubes	2	975,000	978,000	992,000	1,012,000	1,035,000	1,112,000
D. Steam jet air equip	pment	19,250	19,250	19,250	17,500	17,500	31,500
B. Brection F. Deacration - hot we	-11 46	228,000 NONE	230,000	231,000	234,000	240,000	254,000 70,400
cond.	err of					•	, , , , , , ,
G. L-P heaters in exh	Rust stack	28,000	28,000	28,000	14,000	14,000	14,000
3. Circulating Water Syst	tema						
A. Structures							
1. Crib house a. Substructure					1		
b. Superstructur	ra				1		
c. Steel							
d. Miscellaneous	, ,	674,000	675,000	678,000	681,000	687,000	702,000
2. Dredging	ſ				1		
3. Intake flume or	forebay						
4. Seal well					1		
5. Discharge flume 6. Outfall	ŀ				1		
B. Crib house equipmen	t (erected)				1		
1. Traveling screen					į		
2. Screen wash pump							
3. Screen wash pipi		139,000	139,000	140,000	141,000	143,000	148,000
4. Chlorination equ					Į		
5. Chlorine handlin		667,000	669,000	673,000	679,000	688,000	714,000
C. Circulating water p D. Circulating water p		,,	005,000	0.0,000	,	••••	
1. Pumps		330,000	332,000	336,000	342,000	351,000	377,000
2. Motors		189,000	191,000	193,000	196,000	202,000	216,000
Erection		25,600	25,700	25,800	26,000	26,400	27,500
4. Feed Water Heaters							
A. L-P closed heaters		227,000	143,500	145,000	69,000	71,500	100.000
B. H-P closed heaters		263,500	236,500	109,500 203,800	98,500 200,400	134,000	109,000
C. Descrating heater D. Insulation		215,000	208,600	203,000	200,400	234,000	
1. Closed heaters		10,900	8,700	4,800	1,900		
2. Deserators		15,800	15,400	15,000	14,800	10,000	
E. Structural work			17 000	7 000	7,000		
1. For closed heate	rs	21,000 45,000	14,000 43,400	7,000 42,200	41,400	30,000	
For deserators		45,000	40,400	7,200	10,100	.,	
5. Boiler Feed Pumps		300 000	177 000	160 000	162 000	150 000	152,000
A. Pumps and base plate	es	188,000	176,000 128,000	169,000 128,000	162,000	159,000 128,000	128,000
B. Fluid drive C. Motors		161,000 319,000	305,000	288,000	276,000	266,000	260,000
D. Erection		24,500	23,000	22,200	21,300	21,000	20,000
E. Foundation for pumpe	s	6,500	5,900	5,800	5,600	5,500	5,200
6. Condensate Pumps					r r		
A. Pumps		88,500	61,000	61,500	47,000	49,500	
B. Motors		53,000	32,300	32,700	22,900	23,800	
C. Erection		7,700	7,200	7,300	6,900	7,200	
7. Piping and Insulation	_						
A. Extraction steam	7;	318,400	281,500	228,500	210,000	133,500	71,
B. Heater vents and dra	ains _		-				1.57 , 500
C. Peed water piping	_	202,500	202,500	153,900	131,500	96,100	.57,500
D. Condensate piping 1. From condensate p							
through L-P heate		108,900	92,200	92,200	92,500	92,500	
2. To deserator and	1	•	-				
pump suction				** ***	20 500	22 500	22 500
E. Main steam *		24,100	22,500	22,500	22,500	22,500	22,500
8. Demineralizing Equipmen		80 000	100 000	106 000	107 000	177 000	172 000
and Condensate Storage	Tanks	20,300	193,000	185,000	181,000	177,000	173,000
9. Electrical		187,500	181,600	178,400	175,100	174,300	147,600
O. Turbine Room Building		89,000	89,000	89,000	89,000	89,000	89,000
Total Items 1-10	21	,131,950	21,027,750	20,792,350 2	,656,800	20,444,300	20,454,600
Total Constant Cost		242,500	7,242,500		,242,500	7,242,500	7,242,500
Total Turbine Plant Con	et 28	, 374, 450	28,270,250	28,034,850 2	7,899,300	27,686,800	27,697,100
1. Piping In Containment	Vessel	404,500	385,000	436,500	436,500	436,500	360,500
Grand Total		,778,950	28,655,250	28,471,350 2	8,335,800	28,123,300	28,057,600
**							

SUMMARY OF COST DATA 1000 PSIA, 745 F THROTTLE STEAM (200 F SUPERHEAT) 500 MJe INDIRECT CYCLE TURBINE PLANT

Reater Arrangement	6	5	4 -	3	2	
l. Turbine Generator and Accessor				<u> </u>		<u> </u>
A. Turbine generator unit	12,330,000	12,330,000	12,330,000	12,330,000	12,330,000	12,330,000
B. Turbine generator erection	500,000	500,000	500,doo	500,000	500,000	500,000
C. Reserve exciter	4			STANT -	200,000	
D. Turbine foundation	230,000	230,000	230,000	230,000	230,000	230,000
. Condensers			i		•	•
A. Shells and accessories	1 1000 000	1 000 000				
B. Dry vacuum pumps	1,280,000	1,300,000	1,310,000	1,335,000	1,368,000	1,465,000
C. Tubes	911,000	924,000	933,000	944,000	974,000	1,040,000
D. Steam jet air equipment	19,250	19,250	19,250 220,000	17,500	17,500	31,000
E. Erection F. Deseration - hot well of	217,000	219,000	220,000	222,000	227,000	240,000
cond.	NONE			'''		→ 66,000
G. L-P heaters in exhaust stac	k 28,000	28,000	28,000	14,000	14 000	14 000
. Circulating Water System	20,000	20,000	20,000	14,000	14,000	14,000
A. Structures	_					
1. Crib house	1					
a. Substructure]		ļ			
b. Superstructure	1					
c. Steel						
d. Miscellaneous	661,000	663,000	665,000	668,000	673,000	687,000
2. Dradging	ł .		ļ			
 Intake flume or forebay Seal well 	1		•			
5. Discharge flume	l l					
6. Outfall	1					
B. Crib house equipment (erect	ক্র					
l. Traveling screens						
 Screen wash pumps 	Į.		i			
3. Screen wash piping	135,000	135,000	136,000	137,000	139,000	143,000
4. Chlorination equipment			İ			
5. Chlorine handling		647 000	450 000		***	
C. Circulating water piping D. Circulating water pumps	645,000	647,000	652,000	656,000	666,000	690,000
1. Pumps	308,000	311,000	315,000	320,000	328,000	352,000
2. Motors	177,000	178,000	181,000	184,000	189,000	202,000
3. Erection	24,500	24,800	24,900	25,100	25,500	26,400
Feed Water Heaters		•		•	•	•
A. L-P closed heaters	209,500	133,500	125 000	44 000	47 000	
B. H-P closed heaters	245,500	222,500	135,000 103,500	64,000 93,500	67,000	105,000
C. Deserating heater	205,000	199,600	132,100	130,100	128,800	103,000
D. Insulation		,		,	0,000	
1. Closed heaters	10,000	7,500	4,400	1,800		
2. Deserators	15,100	14,800	9,800	9,600	9,500	
B. Structural work						
 For closed heaters For deserators 	21,000	14,000	7,000	7,000		
	42,400	41,000	29,400	28,800	28,400	
Boiler Feed Pumps	175 000					
A. Pumps and base plates	175,000	164,000	158,000	153,000	150,000	146,000
B. Fluid drive	128,000 290,000	128,000 279,000	128,000 262 000	128,000	128,000	128,000
C. Motors D. Brection	22,800	21,500	262,000 20,900	254,000 20,200	245,000 19,900	244,000 19,400
E. Poundation for pumps	6,000	5,600	5,400	5,200	5,300	5,000
	-,	-,		-,	.,	2,
Condensate Pumps	80,500	56,000	E.S. Eho	44,000	46 000	
A. Pumps B. Motors	48,500	30,000	56,500 30,300	21,400	46,000 22,200	
C. Erection	7,100	6,700	6,800	6,500	6,700	
		-,	7,7	-,	•••••	
Piping and Insulation	٦					
A. Extraction steam B. Heater vents and drains	318,200	268,500	228,000	210,000	133,500	71,400
C. Feed water piping	202,500	202,500	153,900	131,500		
D. Condensate piping		202,500	155,500	131,300	96,100	157,500
1. From condensate pumps	1					
through L-P heaters.	> 108,900	92,200	92,200	92,500	92,500	
To deserator and B.F.	ľ		- 1	•	•	
pump suction	<u></u>			_		
E. Main steam	24,100	22,500	22,500	22,500	22,500	22,500
Demineralizing Equipment			1			
and Condensate Storage Tanks	187,000	180,000	173,000	170,000	167,000	165,000
Electrical	177,800	172,900	170,200	167,500	167,100	141,500
Turbine Room Building			170,200	147,300		141,500
			1			
-			19,473,050	19,343,700	19,216,500	19,221,700
Total Items 1-10	19,990,650	19,771,350				
Total Items 1-10 Total Constant Cost	19,990,650 7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Items 1-10 Total Constant Cost Total Turbine Plant Cost						
Total Items 1-10 Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500

SUMMARY OF COST DATA
1000 PSIA, 845 F THROTTLE STEAM
(300 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	3	4	3	2	1
1. Turbine Generator and Accessories	12,330,000	12,330,000	12,330,000			12 220 00
A. Turbine generator unit B. Turbine generator erection	500,000	500,000	500,000	12,330,000 500,000	12,330,000 500,000	12,330,00 500,00
C. Reserve exciter	230,000	230,000		CONSTANT		
D. Turbine foundation	230,000	230,000	230,000	230,000	230,000	230,00
2. Condensers A. Shells and accessories	1,200,000	1,210,000	1,227,000	1,250,000	1,276,000	1,356,00
B. Dry vacuum pumps						
C. Tubes D. Steam jet sir equipment	860,000 19,250	866,000 19,250	876,000 19,250	890,000 17,500	910,000 17,500	964,00
E. Erection	206,000	207,000	209,000	212,000	216,000	31,50 226,00
F. Deseration - hot well of	NONE					-> 61,00
cond. G. L-P heaters in exhaust stack	28,000	28,000	28,000	14,000	14,000	14,00
3. Circulating Water System					•	-
A. Structures						
1. Crib house a. Substructure						
b. Superstructure						
c. Steel						
d. Miscellaneous 2. Dredging	651,000	652,000	653,000	656,000	661,000	672,00
3. Intake flume or forebay				:		
4. Seal well						
5. Discharge flume 6. Outfall						
B. Crib house equipment (erected)						
1. Traveling screens				i		
2. Screen wash pumps 3. Screen wash piping	131,000	132,000	132,000	133,000	135,000	138,00
4. Chlorination equipment	101,000	2,22,000	252,000		200,000	200,000
5. Chlorine handling	626,000	630,000	631,000	637,000	644,000	663,000
C. Circulating water piping D. Circulating water pumps	020,000	-	451,000	037,000	0-4,000	
1. Pumps	290,000	292,000	295,000	300,000	308,000	326,000
2. Motors 3. Erection	167,000 23,900	168,000 24,000	170,000 24,100	172,000 24,300	177,000 24,600	187,000 25,400
. Feed Water Heaters	40,500	,	24,200	24,000	,	-5,
A. L-P closed heaters	197,000	126,000	127,000	61,000	63,000	
B. H-P closed heaters	233,000	211,000	99,000	90,000		101,000
C. Descrating heater D. Insulation	133,100	129,800	127,000	125,200	124, 100	
1. Closed heaters	9,300	7,000	4,200	1,700		
2. Deaerators	9,900	9,600	9,400	9,200	9,100	
E. Structural work 1. For closed heaters	21,000	14,000	7,000	7,000	**=***	
2. For deserators	29,800	28,600	27,800	27,300	27,000	
. Boiler Feed Pumps			,	i		
A. Pumps and base plates	164,000	155,000	150,000	145,000	143,000	140,000
B. Fluid drive C. Motors	128,000 266,000	128,000 255,000	128,000 243,000	128,000 234,000	128,000 226,000	128,000 227,000
D. Erection	21,600	20,400	19,900	19,300	19,000	18,60
E. Foundation for pumps	5,600	5,300	5,200	5,000	4,900	4,80
. Condensate Pumps					10.000	
A. Pumpa B. Motors	74,500 44,900	52,500 28,000	53,000 28,300	20,200	43,000 20,900	
C. Erection	6,700	6,300	6,400	6,100	6,300	
Piping and Insulation				İ		
A. Extraction steam	309,500	268,000	223,500	206,000	132,300	71,400
B. Heater vents and drains		194,800	153,900	131,500	96,100	157,500
C. Feed water piping D. Condensate piping	194,800	194,600	1,3,900	131,500	90,100	15,,50
1. From condensate pumps				1		
through L-P heaters.	108,900	92,200	92,200	85,800	85,800	
2. To deaerator and B.F. pump suction						
E. Main steam	66,500	66,500	61,800	61,800	61,800	61,800
Demineralizing Equipment				1		
and Condensate Storage Tanks	176,000	170,000	164,000	160,000	158,000	157,000 135,100
. Electrical	170,200	165,800	163,600	161,200	161,100	135,100
Turbine Room Building		10 400 050	10 210 550		10 052 500	
Total Items 1-10	19,632,450 7,242,500	19,422,050 7,242,500	19,218,550 7,242,500	19,092,100 7,242,500	18,952,500 7,242,500	18,926,100 7,242,500
Total Constant Cost Total Turbine Plant Cost	26,874,950	26,664,550	26,461,050	26,334,600	26,195,000	26,168,600
Piping In Containment Vessel	608,500	553,000	600,000	600,000	600,000	523,500
Grand Total	27,483,450	27,217,550	27,061,050	26,934,600	26,795,000	26,692,100

SUMMARY OF COST DATA
1000 PSIA, 945 F THROTTLE STEAM
(400 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

		TWEAT CICIE IN	ND INC. I DALLI			
Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories A. Turbine generator unit B. Turbine generator erection C. Reserve exciter	12,450,000 540,000	12,450,000 540,000	12,450,000 540,000	12,450,000 540,000	12,450,000 540,000	12,450,000 540,000
D. Turbine foundation	280,000	280,000	280,000	CONSTANT 280,000	280,000	280,000
2. Condensers A. Shells and accessories B. Dry vacuum pumps	1,136,000	1,155,000	1,158,000	1,175,000	1,204,000	1,271,000
C. Tubes	808,000	815,000	825,000	837,000	857,000	906,000
D. Steam jet air equipment	19,250	19,250	19,250	17,500	17,500	17,500
E. Brection F. Deaeration - hot well of cond.	196,000 None	198,000	200,000	202,000	206,000	214,000 57,200
G. L-P heaters in exhaust stack	28,000	28,000	28,000	14,000	14,000	14,000
A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall 8. Crib house equipment (erected)	640,000	641,000	643,000	645,000	650,000	659,000
1. Traveling screens 2. Screen wash pumps 3. Screen wash piping 4. Chlorination equipment	128,000	128,000	129,000	130,000	131,000	134,000
5. Chlorine handling C. Circulating water piping D. Circulating water pumps	608,000	610,000	614,000	618,000	626,000	642,000
1. Pumps	272,000	274,000	277,000	282,000	290,000	305,000
2. Motors	156,000	158,000 :		162,000	166,000	175,000
3. Erection	23,200	23,300	23,400	23,600	23,900	24,500
. Feed Water Heaters	185,000	119,500	121,500	58,000	60,000	
A. L-P closed heaters B. H-P closed heaters	221,500	202,000	95,000	86,500		97,000
C. Deserating heater D. Insulation	128,200	124,900	122,400	119,900	119,900	
1. Closed heaters	8,800	6,600	3,600	1,600		
2. Deaerators E. Structural work	9,500	9,200	9,000	8,800	8,800	
1. For closed heaters	21,000	14,000	7,000	7,000		
2. For deaerators	28,200	27,200	26,500	25,800	25,800	
. Boiler Feed Pumps A. Pumps and base plates	155,000	147,000	143,000	139,000	137,000	134,000
B. Fluid drive	128,000	128,000	128,000	128,000	128,000	128,000
C. Motors	245,000	236,000	225,000	217,000	212,000	213,000
D. Erection E. Foundation for pumps	20,500 5,300	19,500 5,100	19,000 4,900	18,500 4,800	18,300 4,700	18,000 4,600
• •	3,500	3,100	4,,00	4,500	4,700	4,000
Condensate Pumps A. Pumps	69,000	49,000	50,000	39,000	40,500	
B. Motors	41,800	26,300	26,600	19,100	19,800	
C. Erection	6,300	5,900	6,000	5,800	6,000	
Piping and Insulation			!			
A. Extraction steam	309,500	268,000	223,500	206,000	132,300	71,400
B. Heater vents and drains C. Feed water piping D. Condensate piping	194,800	194,800	153,900	131,500	96,100	157,500
1. From condensate pumps through L-P heaters. 2. To deserator and B.F.	102,000	85,500	85,500	83,400	83,400	****
pump suction B. Main steam	86,100	86,100	86,100	86,100	86,100	76,200
Demineralizing Equipment and Condensate Storage Tanks	166,000	160,000	156,000	153,000	152,000	151,000
Electrical	163,500	159,700	157,800	155,700	155,600	129,800
Turbine Room Building	178,000	178,000	178,000	178,000	178,000	178,000
Total Items 1-10	19,757,450	19,571,850	19,373,950	19,248,600	19,119,700	19,047,700
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	26,999,950	26,814,350	26,616,450	26,491,100	26,362,200	26,290,200
Piping In Containment Vessel	681,000	625,000	676,000	676,000	676,000	586,500
Grand Total	27,680,950	27,439,350	27,292,450	27,167,100	27,038,200	26,876,700

SUMMARY OF COST DATA 800 PSIA, 518 F THROTTLE STEAM (SATURATED STEAM) 500 MMe INDIRECT GYCLE TURBING PLANT

	6	5	4	3	2	<u> </u>
Heater Arrangement						-1 -00 000
1. Turbine Generator and Accessories A. Turbine generator unit B. Turbine generator erection	14,380,000 560,000	14,380,000 560,000	14,380,000 1 560,000 CONSTA	560,000	14,380,000 560,000	14,380,000 560,000
C. Reserve exciter D. Turbine foundation	280,000	280,000	280,000	280,000	280,000	280,000
2. Condensers A. Shells and accessories	1 505 000	1,555,000	1,570,000	1,600,000	1,657,000	1,776,000
B. Dry vacuum pumps	1,535,000		1,115,000	1,140,000	1,190,000	1,280,000
C. Tubes	1,080,000 19,250	1,100,000 17,500	17,500	17,500	17.500	28,000
D. Steam jet air equipment E. Erection	248,000	252,000	255,000	258,000	266,000	281,000 > 80,000
F. Deseration - hot well of	NONE					
cond. G. L-P heaters in exhaust stack	28,000	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall B. Crib house equipment (erected) 1. Traveling screens	697,000	699,000	703,000	707,000	714,000	733,000
2. Screen wash pumps 3. Screen wash piping 4. Chlorination equipment	146,000	147,000	148,000	150,000	152,000	158,000
5. Chlorine handling C. Circulating water piping	705,000	710,000	716,000	724,000	735,000	767,000
D. Circulating water pumps	368,000	372,000	378,000	386,000	397,000	429,000
1. Pumps	213,000	214,000	218,000	222,000	228,000	247,000 29,700
2. Motors 3. Erection	27,100	27,300	27,500	27,900	28,300	25,700
4. Feed Water Heaters	200 000	148,500	150,000	67,000	70,000	
A. L-P closed heaters	229,000 253,000	231,000	110,000	77,500		101,000
B. H-P closed heatersC. Deaerating heater	227,600	220,800	216,000	211,800	209,800	
D. Insulation	11,400	8,800	5,300	1,500	15 600	
1. Closed heaters 2. Deserators	16,800	16,200	15,900	15,600	15,400	
E. Structural work	21,000	14,000	7,000	7,000		
 For closed heaters 	48,300	46,500	45,100	44,000	43,500	
2. For deaerstors	•		,			143,000
5. Boiler Feed Pumps	176,000	164,000	158,000	151,000 128,000	148,000 128,000	128,000
A. Pumps and base plates B. Fluid drive	128,000	128,000 247,000	128,000 231,000	221,000	211,000	214,000
C. Motors	257,000 23,600	22,000	21,300	20,400	20,100	19,500 5,700
D. Erection	7,000	6,500	6,300	6,100	5,900	3,,00
E. Foundation for pumps					56,000	
6. Condensate Pumps A. Pumps	84,000	56,500	58,000 33,400	53,000 25,400	26,600	
B. Motors	52,200	32,900 8,000	8,100	7,800	8,000	
C. Erection	8,600	0,000				
7. Piping and Insulation		200 200	253,500	210,500	172,500	81,400
A. Extraction steam B. Heater vents and drains	357,000	308,000		108,000	74,000	131,200
C. Feed water piping	175,300	175,300	108,000	200,000		
D. Condensate piping 1. From condensate pumps through L-F heatess.	123,600	113,300	113,300	103,200	103,200	
2. To deacrator and B.F. pump suction E. Main steam	35,400	34,500	33,800	32,600	32,200	31,600
8. Demineralizing Equipment	223,000	212,000	205,000	198,000	195,000	192,000
and Condensate Storage Tanks	179,100	174,700		170,200	170,100	
9. Electrical		178,000		178,000	178,000	
10. Turbine Room Building	178,000 23,096,250	22,888,300		22,504,000	22,486,100	
Total Items 1-10	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	
Total Constant Cost Total Turbine Plant Cost	30,338,750	30,130,800	29,896,000	29,746,500	29,728,600 375,000	
ll. Piping In Containment Vessel	455,500	411,000		375,000 30,121,500		
Grand Total	30,794,250	30,541,80	30,283,000	20,222,000	- •	

800 PSIA, 618 F THROTTLE STEAM (100 F SUPERHEAT) 500 MWe INDIRECT CYCLE TURBINE PLANT

	Heater Arrangement	6	5	4	3	2	1
1. Turi	bine Generator and Accessories						·····
A. S	Turbine generator unit Turbine generator erection	13,900,000 560,000	13,900,000 560,000	13,900,000 560,000	13,900,000 560,000	13,900,000 560,000	13,900,000 560,000
C. 1	Reserve exciter	4	300,000		NSTANT	300,000	360,000
	Turbine foundation	280,000	280,000	280,000	280,000	280,000	280,000
2. Cond				į			
A. 5	Shells and accessories	1,439,000	1,450,000	1,465,000	1,487,000	1,520,000	1,635,000
	Ory vacuum pumps	1,024,000	1,031,000	1,040,000	1,060,000	1,081,000	1,155,000
D. S	iteam jet air equipment	19,250	17,500	17,500	17,500	17,500	28,000
E. 8	rection	236,000 NONE	238,000	240,000	243,000	248,000	→ 262,000 → 73,600
	Deseration - hot well of cond,	28,000	28,000	28,000	14,000	14,000	14,000
G. I	P heaters in exhaust stack			.		-	-
3. Circ	ulating Water System						
	tructures . Crib house						
-	a. Substructure						
	b. Superstructure						
	c. Steel d. Miscellaneous	603 000	605 000	407.000	601 000	606 000	710 00
2	. Dredging	> 683,000	685,000	687,000	691,000	696,000	712,000
	. Intake flume or forebay			į			
	. Seal well . Discharge flume			1			
	. Outfall						
	rib house equipment (erected)			-			
	. Traveling screens . Screen wash pumps			-			
	Screen wash piping (> 142,000	142,000	143,000	144,000	146,000	151,000
	Chlorination equipment			Ì			
	. Chlorine handling/ irculating water piping	683,000	686,000	690,000	697,000	704,000	731,000
D. Ci	rculating water pumps						
	Pumps	346,000 197,000	348,000 199,000	352,000 201,000	358,000 204,000	366,000	394,000 225,000
	. Motors . Erection	26,200	26,300	26,400	26,700	209,000 27,000	28,200
Feed	Water Heaters		•	-	•	•	
	P closed heaters	209,500	136,500	138,000	62,000	64,000	
	P closed heaters	231,500	214,000	102,500	74,000	200 000	95,000
	aerating heater sulation	215,000	208,800	204,600	201,800	200,000	
	Closed heaters	10,300	7,900	4,900	1,400		
	Deaerators	15,800	15,400	15,100	14,900	14,800	
	ructural work For closed heaters	21,000	14,000	7,000	7,000		
	For deaerators	45,000	43,400	42,400	41,600	41,000	
Boile:	r Feed Pumps			,			
A. Pu	mps and base plates	160,000	150,000	145,000	139,000	137,000	133,000
C. Mot	uid drive tors	128,000 277,000	128,000 266,000	128,000 252,000	128,000 241,000	128,000 232,000	128,000 235,000
D. Er	ection	21,600	20,300	19,700	19,000	18,800	18,300
E. Fo	undation for pumps	6,400	6,000	5,800	5,600	5,500	5,400
	nsate Pumps	-0.500	51 000	53 50's	10.000		
A. Pur B. Mot		79,500 47,300	51,000 30,100	51,500 30,500	48,000 23,500	50,500 24,400	
C. Ere		7,900	7,400	7,500	7,100	7,400	
Piping	and Insulation			i i			
A. Ext	raction steam 🧻	352,000	308,000	253,500	210,500	172,500	81,400
	ster vents and drains	189,000	189,000	117,300	117,300	74,000	144,700
	ed water piping	*03,000	209,000	117,500	117,500	, 4,000	244,700
1.	From condensate pumps	100.000		70.070		00 500	
	through L-P heaters.	108,900	92,200	92,200	92,500	92,500	
	To deserator and B.F. pump suction .			į			
	n steam	23,500	23,500	21,100	21,100	21,100	21,100
Demine	ralizing Equipment				- 4-5		
and Co	ndensate Storage Tanks	203,000	194,000	187,000	182,000	180,000	178,000
Electr		179,800	175,000	172,600	170,300	169,700	144,800
	ne Room Building	178,000	178,000	178,000	178,000	178,000	178,000
Turb1n	The 1 10	22,273,450	22,049,300	21,806,100	21,667,800	21,579,700	21,511,500
Total							
Total Total	Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	
Total Total Total				7,242,500 29,048,600 346,500	7,242,500 28,910,300 346,500	7,242,500 28,822,200 346,500	7,242,500 28,754,00 343,500

SUMMARY OF COST DATA 800 PSIA, 718 F THROTTLE STEAM (200 F SUPERHEAT) 500 MWe INDIRECT CYCLE TURBINE PLANT

	•••			i		
		5	4	3	2	<u></u>
Heater Arrangement	66			L ,	12,180,000 12,	180,000
1. Turbine Generator and Accessories	12,180,000 500,000	12,180,000 ¹ -500,000	2,180,000 1 500,000 ——— CONSTA	500,000	500,000	500,000
B. Turbine generator erection C. Reserve exciter	230,000	230,000	230,000	230,000	230,000	230,000
D. Turbine foundation				1,408,000	1,440,000	,540,000
2. Condensers A. Shells and accessories	1,340,000	1,350,000	1,399,000	1		,095,000
B. Dry vacuum pumps	956,000	963,000	987,000	1,000,000	17,500	28,000
c Tubes	19,250	17,500	17,500	17,500 233,000	237,000	251,000
D. Steam jet air equipment	225,000	227,000	229,000	233,000		69,300
n Punction	NONE				14 000	14,000
F. Deaeration - hot well of	00.000	28,000	28,000	14,000	14,000	
cond. G. L-P heaters in exhaust stack	28,000					
3. Circulating Water System						
A. Structures						
1. Crib house						
a. Substructure					684,000	695,000
b. Superstructure c. Steel	671,000	672,000	674,000	679,000	904,000	
d, Miscellaneous	811,000	•				
2 Dradging						
3. Intake flume or forebay						
4. Seal well 5. Discharge flume						
∠ 0 ∉a11						
R. Crib house equipment (erected)						147,000
1. Traveling screens		138,000	139,000	141,000	142,000	147,000
2. Screen wash pumps	138,000	138,000	,			
3. Screen wash piping 4. Chlorination equipment				675,000	684,000	709,000
s Chlorine handling	661,000	662,000	667,000	0,5,000		000
o circularing water piping			333,000	338,000	346,000	372,000 212,000
D. Circulating water pumps	324,000	325,000 186,000	189,000	193,000	198,000 26,200	27,300
1. Pumps	185,000	25,400	25,600	25,900	20,200	
2. Motors 3. Erection	25,300	•			60,500	
4. Feed Water Heaters	194,500	128,500	129,500	59,000 71,500		91,000
A 1-P closed heaters	216,500	201,500	96,500	131,000	130,100	
R. H-P closed heaters	205,200	200,200	132,900			
C. Deaerating heater	•	7,300	4,500	1,300	9,600	
D. Insulation 1. Closed heaters	9,500	14,800		9,700	,,000	
2. Deserators	15,100		- 004	7,000		
r structural work	21,000	14,000	7,000		28,800	
1. For closed heaters	42,400	41,200	,,,	,		104 000
2. For deaerators			136,00	131,000	130,000	126,000 128,000
5. Boiler Feed Pumps	148,000			0 128,000		215,000
A. Pumps and base plates	128,000	0/2 00	∧ 229.0U	0 220,000 0 18,100		17,400
g. Fluid drive C. Motors	252,000 20,200	19,10	0 18,69	5,300		5,100
n Rrection	6,000	5,60	0 5,50			
E. Foundation for pumps			0 47,50	0 45,500	47,500	
6. Condensate Pumps	73,000	0 47,00		22.10	0 23,000	
A. Pumpe	43,500	0 28,00 0 6,90		6,70	0 6,900	
B. Motors C. Erection	7,30	· •,,,				as 100
			00 243,0	207,00	0 147,000	81,400
7. Piping and Insulation A. Extraction steam	339,00				=4 000	144,700
n pearer vents and drains	189,00	0 147,0	00 11/,3	00 227,50		
c. Feed water piping	•				92,500	·
n designate ninik	100.00	00 92,2	00 92,3	00 92,50)U 921300	-
1. From condensate pumps through L-P heaters.	108,90	,-	İ			
2. To deaerator and B.F.	1		[100 21,1	00 21,10	0 21,100
pump suction	ز 23,5	00 23,5	500 21,	24,1		
E. Main steam	•		000 175,	000 172,0	00 170,00	
8. Demineralizing Equipment	188,0	00 180,				138,700
and Condensate Storage Tanks	171,3	167,				
g. Electrical					**	A 19 207-00
10. Turbine Room Building	19,884,4	150 19,629,	300 19,421,	900 19,293,1		7,242,50
Total Items 1-10		- 440	500 7,242		0	00 26,449,50
	7.242.	,,,,,,				
Total Constant Cost	7,242,	950 26,871,	800 26,664	400 26,535,		00 343,50
Total Constant Cost	27,126,	950 26,871,	800 26,664, 000 346,	500 346,	500 346,5	00 343,50
Total Constant Cost Total Turbine Plant Cost 11. Piping In Containment Vessel Grand Total	· -	950 26,871, 500 441,	800 26,664, 000 346,	500 346,	500 346,5	00 343,50

SUMMARY OF COST DATA
800 PSIA, 818 F THROTTLE STEAM
(300 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	- 6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit B. Turbine generator erection	12,300,000	12,300,000 500,000	12,300,000 500,000	12,300,000 500,000 ONSTANT	12,300,000 500,000	12,300,000 500,000
C. Reserve exciter D. Turbine foundation	230,000	230,000	230,000	230,000	230,000	230,000
2. Condensers A. Shells and accessories	1,260,000	1,272,000	1,294,000	1,320,000	1,360,000	1,450,000
B. Dry vacuum pumps C. Tubes	900,000	907,000	923,000	940,000	963,000	1,034,000
D. Steam jet air equipment E. Erection	19,250 214,000	17,500 215,000	17,500 217,000	17,500 221,000	17,500 227,000	28,000 238,000 65,300
F. Deaeration - hot well of	NONE		1			05,500
cond. G. L-P heaters in exhaust stack	28,000	28,000	28,000	14,000	14,000	14,000
A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall	658,000	660,000	663,000	667,000	672,000	686,000
B. Crib house equipment (erected)			ļ			
1. Traveling screens 2. Screen wash pumps 3. Screen wash piping 4. Chlorination equipment	134,000	134,000	135,000	137,000	138,000	143,000
5. Chlorine handling C. Circulating water piping	640,000	643,000	647,000	654,000	662,000	686,000
D. Circulating water pumps 1. Pumps	303,000	306,000	9 310,000	317,000	326,000	349,000
2. Motors	173,000	175,000	177,000	181,000	186,000 25,400	200,000 26,300
3. Erection	24,500	24,600	24,800	25,000	25,400	20,500
4. Feed Water Heaters A. L-P closed heaters	183,500	121,500	122,500	56,000	57,500	00.000
B. H-P closed heaters C. Deaerating heater D. Insulation	205,500 133,300	191,500 130,200	92,000 128,000	69,500 126,400	125,800	88,000
 Closed heaters Deaerators 	8,900 9,900	6,800 9,700	4,200 9,500	1,200 9,300	9,200	
E. Structural work 1. For closed heaters	21,000	14,000	7,000	7,000		
2. For deaerators	29,800	28,800	28,100	27,600	27,400	2
 Boiler Feed Pumps A. Pumps and base plates 	140,000	132,000	129,000	125,000	124,000	121,000
B. Fluid drive	128,000	128,000	128,000 211,000	128,000 203,000	128,000 198,000	128,000 203,000
C. Motors	230,000 19,000	222,000 18,100	17,700	17,300	17,100	16,800
D. Erection E. Foundation for pumps	5,600	5,300	5,200	5,100	5,000	4,900
6. Condensate Pumps	67,000	44,000	44,500	43,000	44,500	
A. Pumps B. Motors	40,300	26,200	26,500	20,900	21,600	
C. Erection	6,800	6,500	6,500	6,300	6,500	
7. Piping and Insulation A. Extraction steam	339,000	286,000	229,000	192,000	146,500	81,400
B. Heater vents and drains C. Feed water piping	147,000	147,000	117,300	117,300	74,000	144,700
D. Condensate piping 1. From condensate pumps through L-P heaters. 2. To deaerator and B.F.	108,900	92,200	92,200	85,800	85,800	
pump suction	66,800	66,200	66,200	61,700	61,700	61,700
 Demineralizing Equipment and Condensate Storage Tanks 	176,000	170,000	165,000	162,000	161,000	161,000
9. Electrical	164,300	160,700	159,100	157,500	157,900	133,300
O. Turbine Room Building	19,614,350	19,418,800	19,254,800	19,145,400	19,072,400	19,093,400
Total Items 1-10 Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost 1. Piping In Containment Vessel	26,856,850 455,000	26,661,300 441,000	26,497,300 438,500	26,387,900 424,500	26,314,900 424,500	26,335,900 422,000

SUMMARY OF COST DATA 800 PSLA, 1000 F THROTTLE STEAM (500 F SUPERHEAT) 500 MWe INDIRECT CYCLE TURBINE PLANT

				•		
Heater Arrangement	6 '	<u>,</u> 3	4	3	2	1
Turbine Generator and Accessories A. Turbine generator unit B. Turbine generator erection	13,140,000 500,000	13,140,000 500,000	13,140,000 500,000	13,140,000 500,000	13,140,000 500,000	13,140,000 500,000
C. Reserve exciter D. Turbine foundation	230,000	230,000	230,000	230,000	230,000	230,000
2. Condensers A. Shells and accessories B. Dry vacuum pumps	1,108,000	1,130,000	1,150,000	1,172,000	1,203,000	1,298,000
C. Tubes	795,000	806,000	816,000	835,000	865,00 0	925,000
D. Steam jet air equipment E. Erection	19,250 194,000	17,500 196,000	17,500 198,000	17,500 202,000	17,500 206,000	28,000 218,000
F. Deseration - hot well of	NONE		2,0,000		200,000	68,000
cond. G. L-P heaters in exhaust stack	28,000	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall	637,000	639,000	641,000	645,000	651,000	663,000
B. Crib house equipment (erected) 1. Traveling screens 2. Screen wash pumps 3. Screen wash piping	127,000	128,000	128,000	130,000	131,000	136,000
4. Chlorination equipment 5. Chlorine handling C. Circulating water piping	603,000	607,000	611,000	618,000	626,000	649,000
D. Circulating water pumps						810 000
1. Pumps 2. Motors	267,000	271,000 155,000	275,000 157,000	282,000 161,000	290,000 166,000	312,000 176,000
3. Erection	152,000 23,000	23,100	23,300	23,600	23,900	24,800
4. Feed Water Heaters A. L-P closed heaters	166,500	111,000	112,000	51,500	53,000	
B. H-P closed heaters	188,000	176,500	85,500	66,500		82,500
C. Deaersting heater D. Insulation	124,000	121,100	119,000	118,300	117,800	
1. Closed heaters	7,900	6,100	3,800	1,100		
2. Deaerators E. Structural work	9,100	8,900	8,800	8,700	8,600	
 For closed heaters For deserators 	21,000 26,900	14,000 26,100	7,000 25,600	7,000 25,300	25,700	
. Boiler Feed Pumps	126,000	120,000	117,000	115,000	114,000	112,000
A. Pumps and base plates B. Fluid drive	128,000	94,000	94,000	94,000	94,000	94,000
C. Motors	197,000	191,000	182,000	177,000	174,000	178,000
D. Erection	17,400	16,600	16,300	16,000	15,900	15,600
E. Foundation for pumps	5,000	4,900	4,800	4,700	4,600	4,600
. Condensate Pumps A. Pumps	59,000	39,000	39,500	38,500	39,500	
B. Motors	35,200	23,300	23,600	19,300	19,500	
C. Erection	6,000	5,800	5,800	5,700	5,900	
Piping and Insulation A. Extraction steam				*** ***	180 /00	03 /00
B. Heater vents and drains	326,700	276,500	216,500	192,000	128,400	81,400
C. Feed water piping D. Condensate piping	147,000	147,000	117,300	117,300	74,000	144,700
1. From condensate pumps through L-P heaters. 2. To deaerator and B.F. pump suction	102,000	83,100	83,100	68,400	68,400	
E. Main steam	100,300	100,300	100,300	100,300	100,300	100,300
. Demineralizing Equipment and Condensate Storage Tanks	158,000	153,000	150,000	148,000	147,000	147,000
. Electrical	152,500	150,100	148,900	148,200	148,600	124,100
). Turbine Room Building	10 026 750	10 729 000	10 575 600	19 608 300	19,402,100	19,462,000
Total Items 1-10	19,926,750	19,738,900	19,575,600	19,408,300 7,242,500	7,242,500	7,242,500
Total Constant Cost	7,242,500	7,242,500	7,242,500	26,650,800	26,644,600	26,704,500
Total Turbine Plant Cost	27,169,250 425,500	26,981,400 425,500	623,500	623,500	623,500	620,000
Piping In Containment Vessel Grand Total	27,594,750	27,406,200	27,441,600	27,274,300	27,268,100	27,324,500
Granto Total	,,					

SUMMARY OF COST DATA
600 PSIA, 486 F THROTTLE STEAM
(SATURATED STEAM)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	5	4			
1. Turbine Generator and Accessories		. 3.		2	1
A. Turbine generator unit	14,110,000	14,110,000	14,110,000	14,110,000	14 110 000
B. Turbine generator erection	560,000	560,000	560,000	560,000	14,110,000 560,000
C. Reserve exciter			CONSTANT	500,000	
D. Turbine foundation	280,000	280,000	280,000	280,000	280,000
2. Condensers				•	•
A. Shells and accessories	1,630,000	1 666 000	, , , , , , , , , , , , , , , , , , , ,		
B. Dry vacuum pumps		1,665,000	1 703,000	1,730,000	1,863,000
C. Tubes	1,180,000	1,200,000	1,220,000	1,260,000	1,340,000
D. Steam jet air equipment E. Erection	15,750	15,750	14,000	14,000	21,000
F. Deaeration - hot well of	263,000 NONE	267,000	272,000	279,000	293,000
cond.	HOIL				84,000
G. L-P heaters in exhaust stack	28,000	28,000	14,000	14,000	14,000
. Circulating Water System				•	
A. Structures			-		
1. Crib house					
a. Substructure			ĺ	,	
b. Superstructure c. Steel	711 000		1		
d. Miscellaneous	711,000	716,000	722,000	729,000	745,000
2. Dredging					
3. Intake flume or forebay			İ		
4. Seal well			į		
5. Discharge flume			1		
6. Outfall B. Crib house equipment (erected)					
1. Traveling screens			Ì		
2. Screen wash pumps	151,000	153,000	154,000	157,000	162,000
 Screen wash piping 	· ·		k	207,000	202,000
4. Chlorination equipment			:		
5. Chlorine handling	721 000	777 000			
C. Circulating water piping D. Circulating water pumps	731,000	738,000	748,000	761,000	787,000
1. Pumps	393,000	401,000	410,000	423,000	449,000
2. Motors	225,000	230,000	235,000	242,000	258,000
3. Erection	28,200	28,400	28,800	29,400	30,400
Feed Water Heaters					
A. L-P closed heaters	175,000	178,000	87,500	91,500	
B. H-P closed heaters	232,500	107,000	99,000		116,500
C. Deaerating heater	227,000	220,600	216,400	212,800	
D. Insulation 1. Closed heaters	9,300	5,600	2,400		
2. Deaerators	16,700	16,200	15,900	15,700	
E. Structural work	•	,	,,,,,,,	-5,1	
 For closed heaters 	14,000	7,000	7,000		
For deaerators	48,000	46,600	45,200	44,400	
Boiler Feed Pumps					
A. Pumps and base plates	148,000	141,000	133,000	130,000	123,000
B. Fluid drive	128,000	94,000	94,000	94,000	94,000
C. Motors D. Erection	205,000 20,500	190,000 19,600	:185,000 18,700	174,000	178,000 17,500
E. Foundation for pumps	6,900	6,600	6,300	18,300 6,10 0	17,500 5,900
	•		**	-,	2,200
Condensate Pumps A. Pumps	73,500	74,000	56 600	59,500	
B. Motors	39,400	39,900	56,600 26,700	27,700	
C. Erection	8,400	8,600	8,000	8,400	
Piping and Insulation		•		•	
A. Extraction steam	266 000	016		***	
B. Heater vents and drains	266,000	218,500	196,300	119,000	57,000
C. Feed water piping	156,600	145,200	99,700	61,000	126,400
D. Condensate piping			i		
1. From condensate pumps	113,300	113,300	103,200	103 200	*
through L-P heaters. 2. To deaerator and B.F.	110,000	223,300	,100,000	103,200	
pump suction					
E. Main steam	42,600	41,400	40,200	39,000	39,000
Demineralizing Equipment	•	•	•	•	,
and Condensate Storage Tanks	222,000	212,000	205,000	200,000	197,000
Electrical	170,500		-	-	
	178,000	168,500 178,000	166,700 178,000	166,400 178,000	141,100
Turbine Room Building					178,000
Total Items 1-10	22,808,150	22,623,750	22,461,600	22,337,400	22,269,800
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	30,050,650	29,866,250	29,704,100	29,579,900	29,512,300
			257 000	345,000	220 000
Piping In Containment Vessel Grand Total	432,000 30,482,650	381,000 30,247,250	354,000 30,058,100	29,924,900	339,000 29,851,300

SUMMARY OF COST DATA
600 PSIA, 586 F THROTTLE STEAM
(100 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	<u> </u>	4	3		2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	13,750,000	13,750,000	13,750,		13,750,000	13,750,000
B. Turbine generator erection	560,000	560,000	560,		560,000	560,000
C. Reserve exciter D. Turbine foundation	280,000	280,000	280,	CONSTA 000	280,000	280,000
2. Condensers						
A. Shells and accessories	1,520,000	1,542,000	1,570,	000	1,607,000	1,690,000
B. Dry vacuum pumps						1,205,000
C. Tubes D. Steam jet air equipment	1,080,000 15,750	1,095,000 15,750	1,115,		1,145,000 14,000	21,000
E. Erection	247,000	250,000	255,	000	259,000	271,000
F. Deseration - hot well of	NONE					76,000
cond.						
G. L-P heaters in exhaust stack	28,000	28,000	14,	00	14,000	14,000
A. Structures						
1. Crib house a. Substructure						
b. Superstructure			Į			
c. Steel	695,000	698,000	702,	000	708,000	721,000
d. Miscellaneous			}			
2. Dredging	Na		- 1			
3. Intake flume or forebay						
4. Seal well			1			
5. Discharge flume 6. Outfall						
B. Crib house equipment (erected)			1			
1. Traveling screens			Į.			
2. Screen wash pumps	146,000	147,000	148,	000	150,000	154,000
3. Screen wash piping						
4. Chlorination equipment			Ì			
5. Chlorine handling	703 000	708,000	715.	000	725,000	747,000
C. Circulating water piping	703,000	700,000	,,,,	,,,,	745,000	747,000
D. Circulating water pumps 1. Pumps	365,000	371,000	375,	000	387,000	408,000
2. Motors	210,000	213,000	217,	000	223,000	234,000
3. Brection	27,000	27,200	27,	500	27,900	28,700
4. Feed Water Heaters						
A. L-P closed heaters	160,500	162,000	81,	500	83,000	
B. H-P closed heaters	210,000	97,500	91,			104,000
C. Deaerating heater	215,200	210,000	206,	000	203,600	
D. Insulation						
1. Closed heaters	8,300	5,100	15,	200	15,000	••••
2. Deserators	15,800	15,500	13,		.5,000	
 B. Structural work 1. For closed heaters 	14,000	7,000	7,0	000		
2. For deaerators	45,000	43,600	42,	500	42,000	
			' 1			
5. Boiler Feed Pumps A. Pumps and base places	135,000	129,000	123,	000	120,000	115,000
B. Fluid drive	128,000	128,000	128,		128,000	128,000
C. Motors	235,000	219,000	211,		202,000	204,000
D. Erection	19,500	18,200	17,		17,000	16,500
E. Foundation for pumps	6,300	6,100	5,1	800	5,700	5,500
6. Condensate Pumps						
A. Pumps	66,000	67,000	52		53,000	
B. Motors	36,000	36,400	25		25,400 7,700	
C. Erection	7,800	7,800	7 9 -	500	7,700	
7. Piping and Insulation			İ			
A. Extraction steam	266,000	218,500	196.	300	119,000	57,000
B. Heater vents and drains			1		68,000	137,000
C. Feed water piping	172,500	129,700	129,	,00	60,000	137,000
D. Condensate piping			Ĭ			
1. From condensate pumps through L-P heaters.	92,200	92,200	92	500	92,500	
2. To deserator and B.F.	•	·	ļ			
pump suction			1		75 000	25 200
E. Main steam	35,200	35,200	35,	200	35,200	35,200
8. Demineralizing Equipment						
and Condensate Storage Tanks	203,000	196,000	189,	000	185,000	183,000
9. Electrical	172,200	169,700	167	400	166,900	141,000
	178,000	178,000	178		178,000	178,000
10. Turbine Room Building			1			
Total Items 1-10	22,048,250	21,856,450	21,746.	300 500	21,596,900 7,242,500	21,463,900 7,242,500
Total Constant Cost	7,242,500	7,242,500	7,242, 28,988	900 800		28,706,400
Total Turbine Plant Cost	29,290,750	29,098,950			28,839,400	333,500
ll. Piping In Containment Vessel	403,500	333,300	333.		333,500	
Grand Total	29,694,250	29,432,250	29,322,	300	29,172,900	29,039,900

SUMMARY OF COST DATA
600 PSIA, 686 F THROTTLE STEAM
(200 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	5	4		2	7
1. Turbine Generator and Accessories					
A. Turbine generator unit	13,270,000	13,270,000	13,270,000	13,270,000	13,270,000
B. Turbine generator erection	540,000	540,000	540,000	540,000	540,000
C. Reserve exciter			CONSTANT -	<u>-</u>	
D. Turbine foundation	280,000	280,000	280,000	280,000	280,000
2. Condensers					
A. Shells and accessories					
B. Dry vacuum pumps	1,430,000	1,440,000	1,460,000	1,490,000	1,574,000
C. Tubes	1,017,000	1,025,000	1,040,000	1,065,000	1,115,000
D. Steam jet air equipment	15,750	15,750	14,000	14,000	21,000
E. Erection	235,000	237,000	240,000	244,000	255,000
F. Deseration - hot well of	none				70,800
cond.					•
G. L-P heaters in exhaust stack	28,000	28,000	14,000	14,000	14,000
. Circulating Water System					
A. Structures					
1. Crib house					
a. Substructure					
b. Superstructure					
c. Steel					
d. Miscellaneous	682,000	684,000	687,000	692,000	703,000
2. Dredging					
3. Inteke flume or forebay					
4. Seal well					
5. Discharge flume			:		
ل 6. Outfall					
B. Crib house equipment (erected)					
1. Traveling screens					
2. Screen wash pumps	142,000	142,000	143,000	145,000	148,000
3. Screen wash piping			į		
4. Chlorination equipment			1		
5. Chlorine handling					
C. Circulating water piping	681,000	685,000	690,000	697,000	716,000
D. Circulating water pumps	2/2 222				
1. Pumps	343,000	347,000	352,000	360,000	378,000
2. Motors 3. Erection	197,000	199,000	202,000	207,000	217,000
J. Erection	26,100	26,300	26,500	26.800	27,600
Feed Water Heaters					
A. L-P closed heaters	149,500	150,000	74,500	77,000	
B. H-P closed heaters	194,500	90,500	85,000		97,500
C. Deserating heater	206,000	201,600	134,000	132,700	
D. Insulation					
1. Closed heaters	7,800	4,700	2,100		
2. Deserators	15,200	14,900	10,000	9,900	
E. Structural work	14,000	7,000	7,000		
1. For closed heaters	42,800	41,600	30,000	29,600	
2. For deserators	42,000	41,000	30,000	15,000	
Boiler Feed Pumps					
A. Pumps and base plates	125,000	120,000	115,000	113,000	109,000
B. Fluid drive	128,000	128,000	94,000	94,000	94,000
C. Motors	214,000	199,000	193,000	186,000	189,000
D. Erection	17,700	17,100	16,400	16,200	15,700
E. Foundation for pumps	5,900	5,700	5,500	5,400	5,200
Condensate Pumps			:		
A. Pumps	61,000	61,500	47,500	49,500	
B. Motors	33,500	33,700	23,000	23,800	
C. Erection	7,300	7,300	6,900	7,200	
Piping and Insulation			i		
A. Extraction steam		B. /		11/ ***	
B. Heater vents and drains	262,000	214,000	191,000	114,200	57,000
C. Peed water piping	172,500	129,700	129,700	68 000	137 800
D. Condensate piping	1/4,500	147,700	149,700	68,000	137,800
1. From condensate pumps					
through L-P heaters.	92,200	92,200	92,500	92,500	
		,	- 1-34	,	
2. To deserator and B.F.			:		
E. Main sceam	43,000	43,000	35,200	35,200	35,200
	,	,			
Demineralizing Equipment	100 000	100 000	177 000	175 000	17/ 000
and Condensate Storage Tanks	190,000	182,000	177,000	175,000	174,000
Rlectrical	164,900	162,800	160,600	160,300	134,400
	178,000	178,000	178,000	178,000	178,000
Turbine Room Building			20,766,400	20,612,300	20,556,200
	21,211 650				~~, ~~, ~~
Total Items 1-10	21,211,650	21,003,350			
Total Items 1-10 Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Items 1-10 Total Constant Cost Total Turbine Plant Cost			7,242,500 28,008,900	27,854,800	27,798,700
Turbine Room Building Total Items 1-10 Total Constant Cost Total Turbine Plant Cost Piping In Containment Vessel	7,242,500	7,242,500	7,242,500		

SUMMARY OF COST DATA 600 PSIA, 886 F THROTTLE STRAM (400 F SUPERHEAT) 500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	5	4	3	2	1
. Turbine Generator and Accessories		,		<u> </u>	
A. Turbine generator unit	12,510,000	12,510,000	12,510,000	12,510,000	12,510,000
B. Turbine generator erection	500,000	500,000	500,000	500,000	500,000
C. Reserve exciter			constant -		-
D. Turbine foundation	230,000	230,000	230,000	230,000	230,000
Condensers			ì		
A. Shells and accessories	1,250,000	1,270,000	1,296,000	1,325,000	1,397,000
B. Dry vacuum pumps					
C. Tubes	890,000 19,250	905,000	920,0 0 0	942,000	995,000
D. Steam jet air equipment E. Erection	213,000	19,250 215,000	17,500 217,000	17,500 221,000	22,750 231,000
F. Descrition - hot well of	NONE	223,000	-17,040	,	62,800
cond.			ĺ	-	,
G. L-P heaters in exhaust stack	28;000	28,000	14,000	14,000	14,000
Circulating Water System A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel					
d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall B. Crib house equipment (erected)	657,000	659,000	662,000	667,000	678,000
Traveling screens Screen wash pumps Screen wash piping Chlorination equipment	133,000	134,000	135,000	137,000	140,000
5. Chlorine handling C. Circulating water piping	637,000	641,000	646,000	656,000	673,000
D. Circulating water pumps		+ ,			
1. Pumps	301,000	305,000	310,000	318,000	336,00
2. Motors	173,000	175,000	178,000	183,000	193,00
3. Erection	24,400	24,500	24,700	25,100	25,800
Feed Water Heaters					
A. L-P closed heaters	132,000	133,500	66,000	68,000	
H-P closed heaters	172,500	81,000	76,500		88,00
Descrating heater	129,800	126,800	124,700	123,400	
1. Closed heaters	6,800	4,200	1,800		
2. Deaerators	9,600	9,400	9,200	9,100	
E. Structural work	,,,,,,,	,,,,,,,	,,_,	3,	
1. For closed heaters	14,000	7,000	7,000		
2. For deserators	28,700	27,700	27,100	26,800	
oiler Feed Pumps			′		
. Pumps and base plates	111,000	107,000	103,000	102,000	99,00
. Fluid drive	94,000	94,000	94,000	94,000	94,00
. Motors	182,000	170,000	165,000	160,000	164,00
. Erection	16,000	15,500	14,900	14,700	14,40
. Foundation for pumps	5,300	5,200	5,000	4,900	4,80
ondensate Pumps			P 2		
. Pumps	53,000	53,500	42,000	43,500	
. Motors	29,300	29,500	20,500	21,100	
. Erection	6,400	6,400	6,200	6,400	
iping and Insulation					
. Extraction steam	246,300	199,000	164,800	98,600	57,00
. Heater vents and drains			l		
. Feed water piping . Condensate piping 1. From condensate pumps	136,800	129,700	129,700	68,000	137,80
through L-P heaters. 2. To deserator and B.F.	92,200	92,200	85,800	85,800	
pump suction . Main steam	85,200	85,200	85,200	85,20	85,20
emineralizing Equipment nd Condensate Storage Tanks	169,000	163,000	160,000	157,000	158,000
lectrical			149,800	149,500	124,60
	153,000	151,400	149,800	149,300	
urbine Room Building					10.005.16
otal Items 1-10	19,438,550	19,306,050	19,198,400	19,063,600	19,035,150
otal Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,50
		25 670 550	26,440,900	26,306,100	26,277,65
	26,681,050	26,548,550			
Total Turbine Plant Cost Piping In Containment Vessel Grand Total	26,681,050 454,000 27,135,050	451,500 27,000,050	451,900 26,892,400	451,500 26,757,600	383,000 26,660,650

SUMMARY OF COST DATA
600 PSIA, 986 F THROTTLE STEAM
(500 F SUPERHEAT)
500 MWW INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	5	4	3	2	1
1. Turbine Generator and Accessories				***************************************	
A. Turbine generator unit B. Turbine generator erection	12,870,000 500,000	12,870,000 500,000	12,870,000 500,000 ——— CONSTANT —	12,870,000 500,000	12,870,000 500,000
C. Reserve exciter D. Turbine foundation	230,000	230,000	230,000	230,000	230,000
2. Condensers A. Shells and accessories B. Dry vacuum pumps	1,149,000	1,197,000	1,200,000	1,239,000	1,300,000
C. Tubes	839,000	850,000	861,000	881,000	925,000
D. Steam jet air equipment	19,250	19,250	17,500	17,500	22,750
E. Erection	202,000	204,000	206,000	210,000	219,000
F. Deseration - hot well of	NONE				→ 58,500
cond. G. L-P heaters in exhaust stack	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System A. Structures 1. Orib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall B. Crib house equipment (erected)	646 _x 000	648,000	6 50,000	655,000	664,000
1. Traveling screens	120.000	131 000	121 000	133 000	136,000
2. Screen wash pumps 3. Screen wash piping	130,000	131,000	131,000	133,000	130,000
4. Chlorination equipment			:		
5. Chlorine handling			İ		
C. Circulating water piping	618,000	622,000	626,000	638,000	650,000
D. Circulating water pumps	,	•	'		
1. Pumps	282,000	286,000	290,000	297,000	313,000
2. Motors	162,000	164,000	166,000	171,000	180,000
3. Erection	23,600	23,800	23,900	24,200	24,900
4. Feed Water Heaters					
A. L-P closed heaters	125,000	126,500	62,000	64,500	94.000
B. H-P closed heaters	164,000	77,000	73,000	110 200	84,000
C. Deserating heater D. Insulation	125,100	122,200	120,300	119,300	
1. Closed heaters	6,500	3,900	1,700		
2. Deserators	9,200	9,000	8,900	9,800	
E. Structural work	-				
 For closed heaters 	14,000	7,000	7,000		
For deaerators	27,300	26,400	25,900	25,700	
5. Boiler Feed Pumps			ļ		
A. Pumps and base plates	105,000	102,000	98,000	97,000	95,000
B. Fluid drive	94,000	94,000	94,000	94,000	94,000 153,000
C. Motors	168,000 15,200	157,000 14,800	153,000 14,300	149,000 14,200	13,900
D. Erection E. Foundation for pumps	5,100	4,900	4,800	4,700	4,600
, ,	•,	.,	.,	•	•
6. Condensate Pumps	50,000	50,500	39,500	41,000	
A. Pumps B. Motors	27,500	27,700	19,300	19,900	
C. Erection	6,000	6,100	5,800	6,000	
7. Piping and Insulation					
A. Extraction steam	244 200	100.000	144 900	00 500	57,000
B. Heater vents and drains	246,300	199,000	164,800	98,600	
C. Feed water piping D. Condensate piping	136,800	129,700	129,700	68,000	137,800
1. From condensate pumps through L-P heaters. 2. To deaerator and B.F.	85,500	85,500	83,400	83,400	
pump suction E. Main steam	98,500	98,500	98,500	98,500	98,500
8. Demineralizing Equipment and Condensate Storage Tanks	160,000	155,000	152,000	150,000	151,000
9. Electrical	147,900	146,500	145,000	145,000	119,800
10. Turbine Room Building	~~~~				
Total Items 1-10	19,515,750	19,416,250	19,286,300	19,168,300	19,115,750
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	26,758,250	26,658,750	26,528,800	26,410,800	26,358,250
11. Piping In Containment Vessel	637,500	635,000	635,000	635,000	635,000
Grand Total	27,395,750	27,293,750	27,163,800	27,045,800	26,993,250

SUMMARY OF COST DATA 400 PSIA, 445 F THROTTLE STEAM (SATURATED STEAM) 500 MW INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	4	3	 	
1. Turbine Generator and Accessories	· · · · · · · · · · · · · · · · · · ·	<u> </u>	1 2	<u></u>
A. Turbine generator unit	14,050,000	14,050,000	14,050,000	14,050,000
B. Turbine generator erection	520,000	520,000	520,000	520,000
C. Reserve exciter	←	CONST	4nt ————	
D. Turbine foundation	230,000	230,000	230,000	230,000
2. Condensers				
A. Shells and accessories	1,840,000	1,860,000	1,895,000	2,020,000
B. Dry vacuum pumps			1	
C. Tubes	1,360,000	1,385,000	1,390,000	1,470,00
D. Steam jet air equipment B. Erection	15,750 290,000	14,000 292,000	14,000 296,000	17,50 314,00
F. Deseration - hot well of	NONE		270,000	→ 90,00
cond.	******			, ,,,,,
G. L-P heaters in exhaust stack	28,000	14,000	14,000	14,00
. Circulating Water System				
A. Structures				
1. Crib house				
a. Substructure				
b. Superstructure c. Steel	741,000	743,000	749,000	767,000
d. Miscellaneous	741,000	743,000	743,000	707,000
2. Dredging				
3. Intake flume or forebay				
4. Seal well				
5. Discharge flume				
6. Outfall			•	
B. Crib house equipment (erected)			į.	
1. Traveling screens 2. Screen wash pumps	161,000	161,000	163,000	169,00
3. Screen wash piping	202,000	202,000		,
4. Chlorination equipment				
5. Chlorine handling			_	
C. Circulating water piping	781,000	785,000	794,000	825,000
D. Circulating water pumps	*** 000	446 000	VEE 000	486,000
1. Pumps	442,000 254,000	446,000 256,000	455,000 262,000	279,00
2. Motors	30,200	30,300	30,700	32,00
3. Erection	30,200	50,500	30,110	,
Feed Water Heaters	208,000	87,500	90,000	
A. L-P closed heaters B. H-P closed heaters	106,000	120,500		103,00
C. Deaerating heater	230,000	224,400	219,600	
D. Insulation				
1. Closed heaters	6,400	3,100		
Deaerators	16,900	16,500	16,100	
E. Structural work	7 000	7,000	<u></u>	
1. For closed heaters	7,000 49,000	47,600	46,000	
2. For deaerators	47,000	4.,000	,	
Boiler Feed Pumps	126 000	117 000	112 000	105,000
A. Pumps and base plates	126,000 94,000	117,000 94,000	112,000 94,000	94,00
B. Fluid drive	144,000	145,000	134,000	142,00
C. Motors D. Erection	18,800	17,600	17,000	16,100
E. Foundation for pumps	7,100	6,700	6,400	6,10
	,		İ	
Condensate Pumps A. Pumps	82,000	62,000	64,000	
B. Motors	49,500	29,700	30,500	
C. Erection	9,300	8,700	8,900	
Piping and Insulation				
A. Extraction steam				
B. Heater vents and drains	226,000	222,500	135,300	81,200
C. Feed water piping	105,000	105,000	40,000	88,000
D. Condensate piping	•	•		•
1. From condensate pumps	***			
through L-P heaters.	119,500	103,200	109,400	
2. To deaerator and B.F.				
pump suction	53,500	51,000	49,000	49,000
	20,000	,000	.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	,000
	222 000	910 000	211 000	206 000
Demineralizing Equipment	222,000	218,000	211,000	206,000
and Condensate Storage Tanks		164,700	163,900	138,000
and Condensate Storage Tanks Electrical	167,000			
and Condensate Storage Tanks Electrical				
and Condensate Storage Tanks Electrical Turbine Room Building	167,000		22,409,800	
and Condensate Storage Tanks Electrical Turbine Room Building Total Items 1-10	167,000 22,790,050	22,638,00	22,409,800	22,311,900
and Condensate Storage Tanks Electrical Turbine Room Building Total Items 1-10 Total Constant Cost	167,000 22,790,050 7,242,500	22,638,00 7,242,500	22,409,800 7,242,500	22,311,900 7,242,500
and Condensate Storage Tanks Electrical Turbine Room Building Total Items 1-10 Total Constant Cost Total Turbine Plant Cost	167,000 22,790,050 7,242,500 30,032,550	22,638,00 7,242,500 29,880,500	22,409,800 7,242,500 29,652,300	22,311,900 7,242,500 29,554,400
Demineralizing Equipment and Condensate Storage Tanks Electrical Turbine Room Building Total Items 1-10 Total Constant Cost Total Turbine Plant Cost Piping In Containment Vessel	167,000 22,790,050 7,242,500	22,638,00 7,242,500	22,409,800 7,242,500	22,311,900 7,242,500

400 PSIA, 545 F THROTTLE STEAM
(100 F SUPERHEAT)
500 NWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	4	3	2	1
. Turbine Generator and Accessories				
A. Turbine generator unit	13,690,000 500,000	13,690,000	13,690,000 500,000	13,690,000 500,000
B. Turbine generator erection	300,000	300,000	TANT	300,000
C. Reserve exciter	230,000	230,000	230,000	230,000
D. Turbine foundation		-50,000	200,000	,
Condensers				
A. Shells and accessories	1,690,000	1,700,000	1,754,000	1,775,000
B. Dry vacuum pumps C. Tubes	1,220,000	1,230,000	1,265,000	1,380,000
D. Steam jet air equipment	15,750	14,000	14,000	17,500
E. Erection	270,000	272,000	277,000	293,000
F. Deaeration - hot well of	NONE -			80,000
cond.				
G. L-P heaters in exhaust stack	28,000	14,000	14,000	14,000
Circulating Water System		į		
A. Structures		1		
1. Crib house		1		
a. Substructure		1		
b. Superstructure		1		
c. Steel d. Miscellaneous				
2. Dredging	721,000	722,000	728,000	745,000
3. Intake flume or forebay		!		
4. Seal well		ĺ		
5. Discharge flume		ĺ		
6. Outfall		i		
B. Crib house equipment (erected)		į		
1. Traveling screens				
2. Screen wash pumps	154,000	154,000	156,000	162,000
3. Screen wash piping	154,000			
4. Chlorination equipment 5. Chlorine handling		ŀ		
C. Circulating water piping	745,000	748,000	759,000	787,000
D. Circulating water pumps	,			•
1. Pumps	402,000	410,000	420,000	448,000
2. Motors	234,000	235,000	242,000	258,000
3. Erection	28,700	28,800	29,300	30,400
Feed Water Heaters				
A. L-P closed heaters	187,000	80,000	82,000	
B. H-P closed heaters	95,500	107,500		94,500
C. Deserating heater	218,000	213,600	210,000	
D. Insulation	5,800	2,800		
1. Closed heaters 2. Demerators	16,000	15,700	15,500	
E. Structural work				
1. For closed heaters	7,000	7,000		
2. For deaerators	45,700	44,600	43,600	
Boiler Feed Pumps				
A. Pumps and base plates	114,000	106,000	103,000	97,000
B. Fluid drive	94,000	94,000	94,000	94,000
C. Motors	184,000	182,000	172,000	175,000
D. Erection	17,300	16,300	15,800	15,100
E. Foundation for pumps	6,500	6,200	6,000	5,700
Condensate Pumps				
A. Pumps	73,500	56,000	58,000	
3. Motors	44,800	27,200	28,100	
. Erection	8,500	8,000	8,200	
iping and Insulation		!		
A. Extraction steam	226 000	222,500	135,300	81,200
3. Heater vents and drains	226,000	i		
. Feed water piping	136,300	136,300	61,300	127,200
. Condensate piping		i		
1. From condensate pumps	104,400	94,000	94,000	
through L-P heaters.	*04° 400	,,,,,,,,		
2. To deaerator and B.F.		ŀ		
. Main steam	31,200	31,200	31,200	31,200
	•	!		
emineralizing Equipment	207,000	201,000	195,000	192,000
ind Condensate Storage Tanks		*		
Electrical	169,300	166,400	165,700	140,600
Turbine Room Building		**************************************		
Total Items 1-10	21,920,250	21,766,100	21,597,000	21,463,400
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500
otal Turbine Plant Cost	29,162,750	29,008,600	28,839,500	28,705,900
iping In Containment Vessel	376,500	366,000	305,500 29,145,000	305,500
				29,011,400

SUMMARY OF COST DATA
400 PSIA, 645 F THROTTLE STEAM
(200 P SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	4	3	2	1
Turbine Generator and Accessories				· · · · · · · · · · · · · · · · · · ·
A. Turbine generator unit	13,450,000	13,450,000	13,450,000	13,450,000
B. Turbine generator erection	540,000	540,000	540,000	540,000
C. Reserve exciter	280,000	280,000 CONS		****
D. Turbine foundation	280,000	280,000	280,000	280,000
Condensers				
A. Shells and accessories	1,578,000	1,600,000	1,655,000	1,770,000
B. Dry vacuum pumps	1,117,000	1,134,000		
C. Tubes	15,750	14,000	1,170,000 14,000	1,281,000 17,500
D. Steam jet air equipment E. Erection	255,000	257,000	265,000	281,000
F. Deseration - hot well of	NONE -			79,700
cond.		j	•	.,,,
G. L-P heaters in exhaust stack	28,000	14,000	14,000	14,000
Circulating Water System				
A. Structures				
1. Crib house		1		
a. Substructure		1		
b. Superstructure				
c. Steel	773,000	706,000	714,000	731,000
d. Miscellaneous		1		
2. Dredging		!		
3. Intake flume or forebay 4. Seal well		i		
5. Discharge flume		1		
6. Outfall		į		
B. Crib house equipment (erected)		1		
1. Traveling screens		ļ		
2. Screen wash pumps	148,000	149,000	152,000	157,000
3. Screen wash piping				
4. Chlorination equipment				
5. Chlorine handling	716 000	722 000	725 000	768,000
C. Cfrculating water piping D. Circulating water pumps	716,000	722,000	735,000	700,000
1. Pumps	378,000	384,000	397,000	425,000
2. Motors	217,000	220,000	228,000	244,000
3. Brection	27,500	27,890	28,300	29,500
Feed Water Heaters	•			
A. L-P closed heaters	172,000	74,500	77,000	
B. H-P closed heaters	87,500	91,500	77,000	83,000
C. Deserating heater	209,000	204,800	202,000	
D. Insulation	-		-	
1. Closed heaters	5,400	2,500		+
2. Deserators	15,400	15,100	14,900	***
E. Structural work	7 000	7.000	*******	******
 For closed heaters For deaerators 	7,000 43,400	7,000	41,600	
	43,400	42,400	41,400	
Boiler Feed Pumps	104.040			
A. Pumps and base places	105,000	98,000	95,000	86,000
B. Fluid drive	94,000 1 68, 000	94,000 165,000	94,000 157,000	94,000 152,000
C. Motors D. Erection	16,200	15,200	14,900	13,800
E. Foundation for pumps	6,100	5,800	5,700	5,200
· ·	-,	-,	2,	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
Condensate Pumps	67,000	51,500	53,500	
l Pumps 3. Motors	41,300	25,500	26,300	
. Erection	7,800	7,400	7,700	
	.,	.,	*****	
iping and Insulation				
Extraction steam	225,000	222,500	132,000	81,000
. Heater vents and drains	136,300	136,300	61,300	127,200
. Condensate piping	,	,	,	
1. From condensate pumps				
through L-P heaters.	104,400	94,000	94,000	
To deserator and B.F.				
pump suction				
. Main steam	31,200	31,200	31,200	31,200
emineralizing Equipment				
nd Condensate Storage Tanks	194,000	187,000	183,000	174,000
Mectrical	162,000	159,800	160,000	133,300
		ļ		
Curbine Room Building	178,000	178,000	178,000	178,000
Cotal Items 1-10	21,529,250	21,406,800	21,048,400	21,226,400
otal Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500
otal Turbine Plant Cost	28,771,750	28,649,300	28,513,900	28,468,900
iping In Containment Vessel	376,500	376,500	305,500	305,500
			28,819,400	28,774,400

SUMMARY OF COST DATA 400 PSIA, 845 F THROTTLE STEAM (400 F SUPERHEAT) 500 MJG INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	4	3	2	1
			- 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	·
A. Turbine Generator and Accessories A. Turbine generator unit	13,690,000	13,690,000	13,690,000	13,690,000
B. Turbine generator erection	540,000	540,000	540,000	540,000
C. Reserve exciter	****	280,000	280,000	280,000
D. Turbine foundation	280,000	200,000	200,000	
. Condensers			1 400 000	1,535,000
A. Shells and accessories B. Dry vacuum pumps	1,360,000	1,380,000	1,420,000	
C. Tubes	971,000	980,000	1,013,000	1,088,000
D. Steam jet air equipment	19,250	17,500	17,500 235,000	21,000 248,000
E. Erection	228,000 NONE	230,000		69,000
F. Deaeration - hot well of	MONA			
cond. G. L-P heaters in exhaust stack	28,000	14,000	14,000	14,000
. Circulating Water System				
A. Structures		j		
1. Crib house				
a. Substructure		į		
b. Superstructure c. Steel	673,000	675,000	681,000	697,000
d. Miscellaneous		j		
2. Bredging				
3. Intake flume or forebay				
4. Seal well				
5. Discharge flume		1		
6. Outfall B. Crib house equipment (erected)				
1. Traveling screens			4/2 400	146.000
2. Screen wash pumps	139,000	139,000	141,000	146,000
3. Screen wash piping				
4. Chlorination equipment				
5. Chlorine handling C. Circulating water piping	665,000	668,000	680,000	706,000
D. Circulating water pumps	*		-10.000	368,000
1. Pumps	328,000	332,000	342,000 197,000	215,000
2. Motors	188,000	190,000 25,600	26,100	27,100
3. Brection	25,500	25,000		-
Feed Water Heaters	150,000	65,000	67,000	
A. L-P closed heaters	76,000	84,000		77,500
B. H-P closed heaters C. Deserating heater	131,200	128,800	127,100	
D. Insulation		2 200		
1. Closed heaters	4,700	2,300 9,500	9,400	
2. Deaerators	9,700	,,500	• • •	
B. Structural work For closed heaters 	7,000	7,000		
2. For deacrators	29,100	28,300	27,800	
. Boiler Feed Pumps		05 000	83,000	80,00
A. Pumps and base plates	91,000	85,000 94,000	94,000	94,00
B. Fluid drive	94,000 142,000	141,000	135,000	141,00
C. Motors	14,400	13,700	13,500	13,10
D. Brection E. Foundation for pumps	5,500	5,200	5,100	5,00
. Condensate Pumps A. Pumps	57,000	44,000	46,000	
B. Motors	35,700	22,300	23,000 6,700	
C. Erection	6,800	6,500	0,700	
. Piping and Insulation		1		01.00
A. Extraction steam	218,500	189,000	114,400	81,20
B. Heater vents and drains	114,100	114,100	61,300	127,20
C. Feed water piping D. Condensate piping		·		
1. From condensate pumps		00 500	92,500	
through L-P heaters.	92,200	92,500	72,500	
2. To demerator and B.F.				
pump suction	56,700	56,700	56,700	56,70
E. Main steam				
, Demineralizing Equipment	172,000	167,000	163,000	164,00
and Condensate Storage Tanks	150,000	148,200	148,400	124,20
. Electrical	•	178,000	178,000	178,00
. Turbine Room Building	178,000	20,843,200	20,728,500	20,786,00
Total Items 1-10	20,970,350		7,242,500	7,242,50
Total Constant Cost	7,242,500	7,242,500	27,971,000	28,028,5
Total Turbine Plant Cost	28,212,850	28,085,700	433,500	431,5
L. Piping In Containment Vessel	535,000	433,000	28,404,500	28,460,0
Grand Total	28,747,850	28,518,700	may 44 - 13 - 14	

SUMMARY OF COST DATA
400 PSIA, 945 F THROTTLE STEAM
(500 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	4	3	2	1
1. Turbine Generator and Accessories	12 910 000	12,810,000	12,810,000	12,810,000
A. Turbine generator unit B. Turbine generator erection	12,810,000 500,000	500,000 ————— CONSI	500,000	500,000
C. Reserve exciter D. Turbine foundation	230,000	230,000	230,000	230,000
2. Condensers A. Shells and accessories	1,275,000	1,292,000	1,330,000	1,434,000
B. Dry vacuum pumps/ C. Tubes	907,000	916,000	948,000	1,024,000
D. Steam jet air equipment	19,250	17,500	17,500	21,000
E. Erection	215,000	217,000	223,000	237,000
F. Deseration - hot well of	NONE -		 	64,000
cond. G. L-P heaters in exhaust stack	28,000	14,000	14,000	14,000
A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay	660,000	662,000	668,000	683,000
4. Seal well 5. Discharge flume 6. Outfall B. Crib house equipment (erected) 1. Traveling screens 2. Screen wash pumps 3. Screen wash piping 4. Chlorination equipment	134,000	135,000	1.37,000	142,000
5. Chlorine handling C. Circulating water piping	642,000	647,000	657,000	682,000
D. Circulating water pumps	306,000	310,000	320,000	344,000
1. Pumps 2. Motors	176,000	178,000	184,000	198,000
3. Erection	24,600	24,700	25,200	26,200
. Feed Water Heaters	129 500	61,500	63,000	
A. L-P closed heaters	138,500 72,000	79,000		73,000
B. H-P closed heaters C. Descrating heater D. Insulation	126,800	124,100	122,800	
1. Closed heaters 2. Deserators E. Structural work	4,500 9,400	2,100 9,100	9,000	
1. For closed heaters 2. For descrators	7,000 27,700	7,000 27,000	26,500	****
		7		
. Boiler Feed Pumps A. Pumps and base plates	85,000	80,000	78,000	76,000
B. Fluid drive	80,000	80,000	80,000	80,000
C. Motors	132,000	130,000	124,000	131,000
D. Erection	13,700	13,100	12,900	12,600 4,800
E. Foundation for pumps	5,200	5,000	4,900	-,
. Condensate Pumps	E2 E00	42,000	43,500	
A. Pumps	53,500 33,400	21,000	21,700	
B. Motors C. Erection	6,400	6,200	6,300	4
. Piping and Insulation A. Extraction steam	218,500	189,000	114,400	81,200
B. Heater vents and drains		•	61,300	127,200
C. Feed water piping D. Condensate piping	114,100	114,100	01,300	, ,
1. From condensate pumps through L-P heaters. 2. To deserator and B.F.	92,200	92,500	92,500	
pump suction B. Main steam	63,100	63,100	59,000	59,000
. Demineralizing Equipment and Condensate Storage Tanks	163,000	158,000	155,000	157,000
. Electrical	145,100	143,500	143,700	119,600
. Turbine Room Building		19,400,500	19,282,200	19,330,600
Total Items 1-10	19,517,950 7,242,500	7,242,500	7,242,500	7,242,500
Total Constant Cost		26,643,000	26,524,700	26,573,100
Maked Milet at a				
Total Turbine Plant Cost Piping In Containment Vessel	26,7 6 0,450 570,500	570,500	449,000	449,000

				SUMA	EFFICIEN	SUPPART OF 1,000 MWe H ₂ O TURBINE PLANT CHARACTERISTICS	OST IN I	E PLANT CH	MARACTERIS	TICS						
No. of Fee	of Feed-water Heater:	B	_,	~	6			5	4		3		ĸ		1	
Pressure	Degrees F Superheat	Act. Steam Temp. of	3	Cost	4	Cost	"	Cost	4	Cost	3	Cost	7	tso3	4	Cost
1500	SAT. 200	596 696 796	35.8 36.6	52.00 52.00 52.01		53.02 51.16 49.87	34.8 37.2	9.55 8.55 8.55 8.55	35.2 36.4	51.79 50.25	35.2 5.4.3	49.60 49.95 14.49	32.1 34.4	51.51 49.92 48.57	3.58 8.44 8.44	25.55 55.65 50.15
2,000	300 300	896 996	39.4 40.6	49.81 49.59		49.25 48.92	38.3	48.74	37.4 38.5	48.43 48.43	36.4 37.5	48.18	35.2	47.95 20.33	33 8 9	48.32
T#00	200 SAT.	587 687 787	35.3 36.3	52.35 50.70	35.0	51.17 51.17 51.05	35.5	50.59 19.37	36.75 10.08	483 888	25.00 25.00 25.00	4855 4855	9000 1587	51.64 49.78 48.72	,,,,,,,	5.02 5.02 5.02 5.02 5.03 5.03 5.03 5.03 5.03 5.03 5.03 5.03
	400	787	40.0	49.60		49.00	39.1	36.8	38.2	18.34	3/°.	36.	3) 2 / 2 /	50.04		56.88
3	88	667				323	35.3	14 14 14	32.	50.19	34.0	3,5	32.9	179	, ,	70.05
ļ	88	967 967				19.46	377	49.06	33 33 24 25	18.67 18.35	90 5.0	18.37	35,1	##. 22.23 22.23	33.5 34.5	με.02 18.02
	SAT.	545 545				53.08 51.23	33.2 34.4	50.05 52.05	33.7 8	50.38 50.38	1.65 9.16	8.13 9.13	31.0 32.2	51. 12.03 14.03	36.59 84.7	8 8 8 5
1000	3 000	74.5 84.5				49.73	36.7	49.25	%% 	18.64	35.4	£ 6.	w J J		12	3 6 6
	SAT.	915			i	2.01	32.0	85. 21.	31.5	7, 1, 1, 2, 2	30.7	16.05	29.9	50.96	28.6	4 6 2 2
900	32 88	816 816			5	5.53 5.23	\$ \$ \$ \$	17.99 18.65	333 25.9	75.00	23 21 21	47.95 49.48	<u>ن</u> ن ن	47.86 47.50	30.6 5.5	17.62 62
	SAT.	484			ŀ	100	30:7	49.54	38	49.21	29.8	49.00	29.0	48.89	27.9	18.87
60	88	6 8 8					32.0	6.2	32 P	6.7	, i	86	ب د د	5.5	39.	\$ 5
	88	986 986					35.6 36.8	45.87 46.15	35.3 36.6	5.63 88	34.8 35.9	45.46 5.67	2) 8-7	45.27 45.51	32.8 8 8	5.61
	SAT.								39.1	. 6 . 6 . 6 . 6	3 % 3 ~7	5 8	8 8	\$ \$.	3 2	8 t
6 6	200	6. y					_		25 20	80	¥; •••	55.65	30.4	, 2; 3; 3; 4;	28.9	55.14
	88	97.5 87.5							2 (2) 2 (2) 2 (2)	6 % 8 %	35 ja 20 0	8.8 8.8	9 8	28. 10. 10.	31.8 8	99 17 74

TABLE 12.6 (SL-2008, p 7)

TABLE 12.7 (SI-2008, pp 171-204)

SUMMARY OF COST DATA 1500 PSIA, 696 F THROTTLE STEAM (100 F SUPERHEAT) 1000 MWe INDIRECT CYCLE TURBINE PLANT

_								
_	Heater Arrangement		6 .	5	4	3	2	1
1.	Turbine Generator and Accessories A. Turbine generator unit B. Turbine generator erection	24,100,000 700,000	24,100,000 700,000	24,100,000 700,000	24,100,000 700,000	24,100,000 700,000	24,100,000	24,100,000
	C. Reserve exciter D. Turbine foundation	345,000	345,000	345,000	CONSTAN 345,000	345,000	345,000	345,000
2,	Condensers A. Shells and accessories B. Dry vacuum pumps C. Tubes D. Steam jet air equipment E. Erection	2,367,000 1,660,000 28,875 368,000	2,550,000 1,805,000 28,875 402,000	2,565,000 1,820,000 26,250 406,000	2,577,000 1,835,000 26,250 408,000	2,640,000 1,880,000 26,250 417,000	2,790,000 1,988,000 26,250 442,000	3,027,000 2,145,000 52,500 477,000
	F. Deseration - hot well of cond.G. L-P heaters in exhaust stack	NONE 50,000	50,000	50,000	50,000	25,000	25,000	→ 136,000 25,000
3.	Circulating Water System A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall B. Crib house equipment (erected) 1. Traveling screens	858,000	894,000	899,000	902,000	912,000	939,000	979,000
	2. Screen wash pumps 3. Screen wash piping 4. Chlorination equipment 5. Chlorine handling	> 193,000	209,000	211,000	212,000	218,000	227,000	245,000
	C. Circulating water piping D. Circulating water pumps	1,154,000	1,206,000	1,212,000		1,231,000	1,269,000	1,324,000
	1. Pumps 2. Motors 3. Erection	563,000 346,000 40,700	613,000 365,000 42,700	618,000 367,000 42,800	623,000 369,000 43,000	637,000 374,000 43,600	673,000 388,000 44,900	727,000 408,000 46,900
	Feed Water Heaters A. L-P closed heaters B. H-P closed heaters C. Deaerating heater D. Insulation 1. Closed heaters 2. Deaerators E. Structural work	384,000 739,500 373,000 34,400 27,500	392,500 430,000 358,000 23,800 26,300	242,500 396,500 348,000 17,700 25,600 21,000	246,500 188,500 341,000 10,400 25,100	127,500 145,500 268,000 3,700 20,000	135,000 266,000 19,700	192,500
_	1. For closed heaters 2. For deserators	42,000 81,000	31,500 76,800	74,100	72,300	60,000	59,200	
:	Boiler Feed Pumps A. Pumps and base plates B. Fluid drive C. Motors D. Brection E. Foundation for pumps	561,000 663,000 819,000 53,000 11,200	528,000 330,000 747,000 50,500 10,600	492,000 333,000 704,000 47,700 9,900	475,000 333,000 668,000 46,400 9,600	454,000 333,000 637,000 44,900 9,200	446,000 333,000 618,000 44,300 9,100	434,000 333,000 611,000 43,300 8,800
1	Condensate Pumps A. Pumps B. Motors C. Brection	129,000 81,100 13,300	132,000 82,900 13,500	104,000 50,800 12,900	106,000 51,800 13,000	80,000 35,100 12,500	86,000 37,200 13,000	
1	Piping and Insulation A. Extraction steam B. Heater vents and drains C. Feed water piping Condensate piping	732,600 500,000	618,000 431,000	534,900 319,000	450,600 294,000	399, <u>6</u> 00 294,000	267,000 174,700	147,600 359,000
•	1. From condensate pumps through L-P heaters. 2. To deaerator and B.F. pump suction	188,700	188,700	166,000	166,000	153,000	153,000	
). c	. Main steam emineralizing Equipment	38,000 254,000	38,000 238,000	38,000 227,000	38,000 220,000	33,700 217,000	33,700 210,000	33,700 208,000
9. 1	nd Condensate Storage Tanks Slectrical	373,200	364,200	351,200	343,400	336,800	337,300	282,800
1	Curbine Room Building [Otal Items 1-10 Total Constant Cost Cotal Turbine Plant Cost Piping In Containment Vessel	38,872,075 11,874,000 50,746,075 1,260,000	38,421,875 11,874,000 50,295,875 862,000	37,877,850 11,874,000 49,751,850 863,000	37,517,350 11,874,000 49,391,350 855,000	37,223,850 11,874,000 49,097,850 849,000	37,199,350 11,874,000 49,073,350 846,000	37,391,100 11,874,000 49,265,100 857,000
	rand Total	52,006,075	51,157,875	50,614,850	50,246,350	49,946,850	49,919,350	50,122,100

SUMMARY OF COST DATA
1500 PSIA, 796 F THROTTLE STEAM
(200 F SUPERHEAT)
1000 MWW INDIRECT CYCLE TURBINE PLANT

Heat	er Arrangement	7	6	5	4	3		1
. Turbine Ge	nerator and Accessor	ia.						
A. Turbine	generator unit	23,300,000	23,300,000	23,300,000	23,300,000		23,300,000	23,300,00
	generator erection	700,000	700,000	700,000	700,000		700,000	700,00
C. Reserve			0/5 000	015.000	— constai		0/5 000	0/5 00
D. Turbine	foundation	345,000	345,000	345,000	345,000	345,000	345,000	345,00
Condensers		_			į.			
	ind accessories	2,374,000	2,400,000	2,415,000	2,430,000	2,490,000	2,625,000	2,850,00
B. Dry vac)	(rum brumba							2,010,00
C. Tubes	t air equipment	1,693,000 28,875	1,705,000 28,875	1,725,000 26,250	1,735,000 26,250	1,775,000 26,250	1,868,000 26,250	52,50
E. Erection		377,000	379,000	384,000	386,000		415,000	447,00
	on - hot well of	NONE		,				→ 128,00
cond.					-			
G. L-P heat	ers in exhaust stac	k 50,000	50,000	50,000	50, q 00	25,000	25,000	25,00
Circulating	Water System							
A. Structur		\neg			[
1. Críb		1			ŀ			
	bstructure				}			
	perstructure				Ì			
c. St	eei scellaneous	866,000	870,000	873,000	877, doc	886,000	910,000	946,00
2. Dredg		٠,	••••	••••				
	e flume or forebay	- 1			İ			
4. Seal		1						
5. Disch	arge flume	Ī						
6. Outfa		⊣			4			
	se equipment (erecte	ed) į			1			
	ling screens	107 000	100 000	200 000	201 400	205,000	214,000	231,00
	n wash pumps n wash piping	197,000	198,000	200,000	201,000	203,000	214,000	231,00
	instion equipment							
	lne handling							
	ing water piping	1,165,000	1,170,000	1,175,000	1,181,000	1,193,000	1,228,000	1,278,00
	ing water pumps				[
1. Pumps		569,000	578,000	584,000	588,000	601,000	634,000	683,00
2. Motor:		351,000	352,000	354,000 41,600	356,000 41, 8 00	361,000 42,200	372,000 43,500	391,00 45,20
3. Erect:		41,200	41,400	41,000	41,400	42,200	45,500	45,20
Feed Water 1		*** ***	*** ***	*** ***		*** ***	10/ 000	
A. L-P close B. H-P close		363,000	361,000	225,500	227,\$00 175,\$00	119,000 137,500	126,000	180,50
C. Deseration		671,000 351,000	395,000 339,000	366,500 264,000	260,000		254,000	
D. Insulation		552,000	337,000	204,000	230,430	250,000	251,111	
1. Closed		31,000	21,500	16,100	9,\$00	3,400	*****	
2. Deaera	tors	25,800	24,900	19,600	19,200	18,960	18,700	
E. Structur				41 400	10 400	10 500		
	osed heaters	42,000	31,500	21,000	10,\$00 57,400		55,600	
2. For de	aerators	75,000	71,800	58,800	37,400	36,300	22,000	
Boiler Feed					1		/13 000	(07.00
	base plates	510,000	483,000	453,000	441,000		417,000 241,000	407,00 241,00
B. Fluid dri	ve	333,000 721,000	333,000 666,000	333,000 632,000	333,000 602,000	241,000 581,000	563,000	560,00
C. Motors D. Erection		49,100	47,000	44,800	43,800		42,100	41,30
E. Foundation	n for pumps	10,200	9,700	9,200	9,000		8,500	8,30
		•		• • •	- [•	-	
Condensate F A. Pumps	curba	121,000	120,000	95,000	97,000	74,000	79,000	
B. Motors		76,000	75,500	46,900	47,800	32,800	34,700	
C. Erection		12,800	12,800	12,300	12,400	12,000	12,400	
	nauineton	-	-	-	-			
Piping and I A. Extractio			/00 TO-	FA! 000	(EQ	969 200	967 000	167 40
	nts and drains	732,600	608,700	534,900	450,600	363,300	267,000	147,60
C. Feed wate	r piping	500,000	431,000	319,000	294,000	294,000	174,700	359,00
D. Condensat		-						
	ondensate pumps	100 700	100 700	166 000	166 000	1/1 000	141,000	
	h L-P heaters.	188,700	188,700	166,000	166,000	141,000	*+1,000	
	erator and B.F.	}			ł			
pump s Rain stea:		97,000	97,000	97,000	97,000	74,000	74,000	74,00
							105 000	106.00
Jemineralizi	ng Equipment	230,000	217,000	209,000	202,000	198,000	195,000	195,00
	te Storage Tanka							
Electrical		354,700	343,700	333,500	329,100	322,600	322,000	268,70
Turbine Room	Building							
Total Items		37,551,975	36,995,075	36,429,950	36,101,50	35,752,910	35,731,450	35,914,10
Total Consta		11,874,000	11,874,000	11,874,000	11,874,000		11,874,000	11,874,00
	e Plant Cost	49,425,975	48,869,075	48,303,950	47,975,050		47,605,450	47,788,10
	e riant Cost ntainment Vessel	1,390,000	1,004,000	1,003,000	994,000		967,000	975,00
	PERSONAL PROPERTY OF THE PROPE	-,,	-,,		1			
riping in Co Grand Total		50,815,975	49,873,075	49,306,950	48,969,850	48,600,910	48,572,450	48,763,10

SUMMARY OF COST DATA 1500 PSIA, 896 F THROTTLE STEAM (300 F SUPERHEAT) 1000 MWe INDIRECT CYCLE TURBINE PLANT

_	Heater Arrangement		6		4	3	22	1
1.	Turbine Generator and Accessorie A. Turbine generator unit B. Turbine generator erection	23,400,000 700,000	23,400,000 700,000	23,400,000	23,400,000	23,400,000 700,000	23,400,000 700,000	23,400,000 700,000
	C. Reserve exciter D. Turbine foundation	345,000	345,000	345,000	CONSTAN 345,000	345,000	345,000	345,000
2.	Condensers A. Shells and accessories B. Dry vacuum pumps	2,205,000	2,235,000	2,250,000	2,280,000	2,310,000	2,430,000	2,640,000
	C. Tubes D. Steam jet air equipment E. Erection F. Deseration - hot well of cond.	1,570,000 28,875 349,000 NOME	1,585,000 28,875 353,000	1,600,000 26,250 356,000	1,619,000 26,250 360,000	1,649,000 26,250 366,000	1,735,000 26,250 386,000	1,871,000 52,500 417,000 118,700
	G. L-P heaters in exhaust stack	50,000	50,000	50,000	50,000	25,000	25,000	25,000
	Circulating Water System A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall B. Crib house equipment (erected)	837,000	840,000	844,000	847,000	855,000	877,000	911,000
	1. Traveling screens 2. Screen wash pumps 3. Screen wash piping 4. Chlorination equipment 5. Chlorine handling —	184,000	185,000	186,000	188,000	192,000	201,000	216,000
	C. Circulating water piping D. Circulating water pumps	1,124,000	1,128,000	1,131,000	1,138,000	1,150,000	1,180,000	1,228,000
	1. Pumps	533,000	538,000	543,000	548,000	559,000	589,000	635,000 373,000
	2. Motors 3. Erection	335,000 39,700	337,000 39,800	338,000 40,000	340,000 40,300	345,000 40,700	356,000 41,800	43,500
4.	Poed Water Heaters	4.,		•	, [_		
	A. L-P closed heaters	335,000	335,000	211,000	214,500	111,500	118,000	171 500
	B. H-P closed heaters C. Deaerating heater D. Insulation	626,500 267,000	370,000 259,000	345,000 254,000	166,000 250,000	133,500 247,000	245,000	171,500
	1. Closed heaters 2. Deserators	28,300 19,800	20,900 19,200	14,900 18,700	8,800 18,400	3,200 18,200	18,000	
	E. Structural work	-	•			-		
	 For closed heaters For deserators 	42,000 59,600	31,500 57,200	21,000 55,600	10,500 54,400	10,500 53,600	53,000	
5.	Boiler Feed Pumps			101 000		401 000	396,000	388,000
	A. Pumps and base plates	470,000 333,000	449,000 333,000	426,000 241,000	415,000 241,000	401,000 241,000	241,000	241,000
	B. Fluid drive C. Motors	651,000	606,000	580,000	557,000	536,000	524,000	522,000
	D. Brection	46,100	44,500	42,700	41,900	40,800	40,500	39,800
	E. Foundation for pumps	9,500	9,100	8,700	8,500	8,200	8,100	8,000
	Condensate Pumps	111,000	110,000	88,000	90,000	69,000	74,000	
	A. Pumps	69,500	69,400	43,500	44,400	30,700	32,400	
	B. Motors C. Erection	12,200	12,200	11,700	11,900	11,500	11,900	
	Piping and Insulation A. Extraction steam	3	/AR #AA	FR4 000	446 200	359,100	263,100	147,600
	B. Heater vents and drains	711,600	608,700	534,900	446,700	•		359,000
	C. Feed water piping D. Condensate piping	412,000	378,000	319,000	294,000	294,000	174,700	339,000
	1. From condensate pumps through L-P heaters. 2. To deserator and B.F.	188,700	188,700	166,000	149,500	136,700	136,700	
	pump suction E. Main steam	124,200	124,200	111,700	111,700	111,700	111,700	111,700
8.	Demineralizing Equipment and Condensate Storage Tanks	212,000	202,000	195,000	190,000	182,000	180,000	180,000
	Electrical	333,500	327,500	319,300	315,000	309,800	306,200	256,900
-0.	Turbine Room Building	36,763,075	36,319,775	35,816,950	35,520,750	35,271,950	35,226,350	35,401,200
	Total Items 1-10 Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
	Total Turbine Plant Cost	48,637,075	48,193,775	47,690,950	47,394,750	47,145,950	47,100,350	47,275,200
11.	Piping In Containment Vessel	1,172,000	1,052,000	1,045,000	1,038,000	1,038,000	1,030,000	1,042,000
	Grand Total	49,809,075	49,245,775	48,735,950	48,432,750	48,183,950	48,130,350	48,317,200

SUMMARY OF COST DATA
1500 PSIA, 996 F THROTTLE STEAM
(400 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

	Heater Arrangement	7	6	5				
1.	Turbine Generator and Accessories			· · · · · · · · · · · · · · · · · · ·				<u>_</u>
	A. Turbine generator unit B. Turbine generator erection C. Reserve exciter	23,560,000 700,000	23,560,000 700,000	23,560,000 700,000	23,560,000 700,000 —— CONSTANT	23,560,000	23,560,000 700,000	23,560,000 700,000
	D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000	345,000
2.	Condensers A. Shells and accessories B. Dry vacuum pumps	2,070,000	2,100,000	2,124,000	2,160,000	2,190,000	2,250,000	2,451,000
	C. Tubes	1,480,000	1,493,000	1,510,000	1,530,000	1,555,000	1,629,000	1,750,000
	D. Steam jet sir equipment E. Erection F. Deseration - hot well of	28,875 329,000 NONE	28,875 332,000	26,250 336,000	26 250 340 000	26,250 346,000	26,250 362,000	52,500 389,000 → 110,000
	cond. G. L-P heaters in exhaust stack	50,000	50,000	50,000	50,000	25,000	25,000	25,000
3.	Circulating Water System A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay	813,000	817,000	821,000	825,000	832,000	851,000	880,000
	4. Seal well 5. Discharge flume 6. Outfall B. Crib house equipment (erected) 1. Traveling screens 2. Screen wash pumps 3. Screen wash piping 4. Chlorination equipment	174,000	176,000	177,000	179,000	182,000	190,000	203,000
	5. Chlorine handling C. Circulating water piping	1,091,000	1,097,000	1,102,000	1,108,000	1,117,000	1,143,000	1,195,000
	D. Circulating water pumps	501 000	FO7 000	F10 000	F17 000	*** ***	een 000	£03 000
	1. Pumps 2. Motors	501,000 324,000	507,000 326,000	512,000 328,000	517 000 330 000	527,000 333,000	563,000 342,000	593,000 357,000
	3. Erection	38,600	38,800	39,000	39 200	39,500	40,500	41,900
4.	Feed Water Hesters							
	A. L-P closed heaters	308,500	310,500	198,000	202,000	106,000	111,000	
	B. H-P closed heaters C. Deacrating heater D. Insulation	588,000 256,400	348,500 249,000	327,000 244,400	157,500 240,400	125,500 238,000	237,000	163,500
	 Closed heaters Deaerators 	25,900 19,200	18,400 18,300	13,900 18,000	8,400 17,700	3,000 17,500	17,400	*****
	E. Structural work 1. For closed heaters	42,000	31,500	21,000	10,500	10,500		
_	2. For deserators	56,200	54,200	52,800	51,800	51,000	50,600	
	Soiler Feed Pumps A. Pumps and base plates	441,000	422,000	402,000	393,000	380,000	377,000	369,000
	3. Fluid drive	333,000	241,000	241,000	241,000	241,000	241,000	241,000
	. Motors	596,000	557,000	535,000	516,000	498,000	489,000	487,000
). Erection	43,800	42,500	40,900	40,300	39,300	39,100	38,500
	. Foundation for pumps	9,000	8,600	8,200	8,100	7,800	7,700	7,600
	ondensate Pumps Pumps	103,000	103,000	82,000	84,000	65,000	69,000	
	. Motors	64,500	64,500	40,800	41,600	28,900	30.500	
	. Erection	11,700	11,700	11,300	11,400		11,500	
	iping and Insulation	711 (00	FO/ 200		446 700	250 100	242 100	147 600
1	. Heater vents and drains	711,600	594,300	534,900	446,700	359,100	263,100	147,600
	. Feed water piping . Condensate piping 1. From condensate pumps	412,000	378,000	319,000	281,06	281,000	174,700	359,000
	through L-P heaters. 2. To descrator and B.F.	176,200	176,200	149,500	149,500	136,700	136,700	
I	pump suction . Main steam	150,800	139,700	139,700	139,700	139,700	139,700	139,700
. I	emineralizing Equipment nd Condensate Storage Tanks	197,000	189,000	184,000	180,000	176,000	175,000	175,000
). 1	Hectrical	327,000	324,100	316,500	313,000	309,400	311,000	258,500
	urbine Room Building	36,377,275	35,852,675	35,510,150	35,243,050	35,002,250	34,907,750	35,028,800
1					!			
	otal Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
						46.876.250	46.781.750	46,902,800
1		48,251,275 1,338,000	47,726,675 1,192,000	47,384,150 1,192,000	47,117,050 1,183,000	46,876,250	46,781,750 1,173,000	46,902,800 1,187,000

SUMMARY OF COST DATA
1400 PSIA, 587 F THROTTLE STEAM
(SATURATED STEAM)
1000 MWe INDIRECT CYCLE TURBINE PLANT

_	Heater Arrangement	7.	6	5	4	3	2	1
1.	Turbine Generator and Accessories A. Turbine generator unit B. Turbine generator erection	25,000,000 700,000	25,000,000 700,000	25,000,000 700,000	25,000,000	25,000,000 700,000	25,000,000 700,000	25,000,000 700,000
	C. Reserve exciter D. Turbine foundation	345,000	345,000	345,000	CONSTAN 345,000	345,000	345,000	345,000
2.	Condensers A. Shells and accessories B. Dry vacuum pumps	2,724,000	2,730,000	2,790,000	2,820,000	2,865,000	3,150,000	3,390,000
	C. Tubes D. Steam jet air equipment E. Brection F. Deaeration - hot well of cond.	2,010,000 28,875 429,000 NONE	2,016,000 28,875 431,000	2,025,000 26,250 435,000	2,040,000 26,250 440,000	2,055,000 26,250 450,000	2,130,000 26,250 474,000	2,370,000 49,875 527,000 152,400
	G. L-P heaters in exhaust stack	50,000	50,000	50,000	50,000	25,000	25,000	25,000
3.	Circulating Water System A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall B. Crib house equipment (erected)	927,000	930,000	934,000	940,000	952,000	978,000	1,040,000
	1. Traveling screens 2. Screen wash pumps 3. Screen wash piping 4. Chlorination equipment	> 223,000	224,000	226,000	228,000	233,000	245,000	271,000
	5. Chlorine handling C. Circulating water piping D. Circulating water pumps	1,251,000	1,255,000	1,261,000	1,269,000	1,285,000	1,323,000	1,409,000
	1. Pumps	656,000	661,000	666,000	675,000 388,000	690,000 394,000	726,000 407,000	810,000 438,000
	 Motors Erection 	382,000 44,300	383,000 44,500	385,000 44,700	45,000	45,500	46,800	50,000
4.	Feed Water Heaters	396,500	400,500	241,000	249,000	121,500	128,500	
	A. L-P closed heaters B. H-P closed heaters C. Deaerating heater D. Insulation	810,000 401,400	479,500 385,500	437,000 373,500	206,500 364,500		353,400	188,500
	1. Closed heaters 2. Deserators E. Structural work	39,100 29,900	26,700 28,500	20,000 27,600	11,600 26,800	3,300 26,300	26,000	
	 For closed heaters For deaerators 	42,000 90,000	31,500 84,900	21,000 81,300	10,500 78,600	10,500 76,900	75,600	
	Boiler Feed Pumps	587,000	546,000	507,000	488,000	464,000	457,000	445,000
	A. Pumps and base plates B. Fluid drive	633,000	333,000	333,000	333,0do	333,000	333,000	333,000
	C. Motors	801,000	722,000	679,000	639,000	606,000	586,000 47,700	589,000 46,700
	D. Brection	58,700 12,700	55,300 11,800	52,000 11,000	50,300 10,600	48,400 10,100	9,900	9,700
	E. Foundation for pumps	22,700	22,000	,			•	
	Condensate Pumps A. Pumps	153,000	152,000	96,000	98,000	90,000	97,000	
	B. Motors	89,000	88,200	53,900	55,100	40,800 13,300	43,700 13,900	
	C. Erection Piping and Insulation	14,750	10,900	13,800	14,000	13,300	15,500	
	A. Extraction steam	730,200	631,800	560,800	455,700	358,200	251,700	147,600
	B. Heater vents and drains C. Feed water piping D. Condensate piping	484,000	441,000	306,500	282,500		161,500	333,500
	1. From condensate pumps through L-P heaters. 2. To deaerator and B.F.	222,500	222,500	203,500	203,500	185,800	185,800	
	pump suction E. Main steam	50,000	50,000	50,000	50,000	37,500	37,500	37,500
в.	Demineralizing Equipment and Condensate Storage Tanks	288,000	270,000	256,000	245,000		233,000	232,000
	Electrical Turbine Room Building	379,600	364,800	352,300	344,500	337,200	336,500	285,000
	Total Items 1-10	41,082,525	40,134,775	39,564,150 11,874,000	39,182,950 11,874,000		38,953,750 11,874,000	39,224,775 11,874,000
	Total Constant Cost	11,874,000	11,874,000	51,438,150	51,056,9\$0		50,827,750	51,098,775
	Total Turbine Plant Cost	1,169,000	52,008,775 1,044,000	934,000	870,000		814,000	804,000
	Piping In Containment Vessel Grand Total	54,125,525	53,052,775	52,372,150	51,926,950		51,641,750	51,902,775

SUMMARY OF COST DATA
1400 PSIA, 687 F THROTTLE STEAM
(100 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

3. Turbine generator erection 700,000 70	700,00 700,00 345,00 3,120,00 2,300,00 49,87 492,00 140,50 25,00 998,00 1,350,00 417,00 47,80	24,100,000 700,000 345,000 2,850,000 2,009,000 26,250 447,000 25,000 25,000 232,000 1,281,000 687,000 393,000 45,400	24,100,000 700,000 345,000 2,700,000 1,950,000 26,250 426,000 25,000 924,000	24,100,000 700,000 CONSTANT 345,000 2,640,000 1,905,000 26,250 417,000 50,000	700,000 345,000 2,610,000 1,875,000 26,250 414,000 50,000	24,100,000 700,000 345,000 2,580,000 1,911,000 28,875 412,000 50,000	24,100,000 700,000 345,000 2,565,000 1,860,000 28,875 411,000 NONE 50,000	1. Turbine Generator and Accessori A. Turbine generator unit B. Turbine generator unit C. Reserve exciter D. Turbine foundation 2. Condensers A. Shells and accessories B. Dry vacuum pumps C. Tubes D. Steam jet air equipment E. Krection F. Deaerstion - hot well of cond. G. L-P heaters in exhaust stack 3. Circulating Water System A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall
A. Turbine generator unit B. Turbine generator exection C. Reserve exciter D. Turbine foundation 345,000 345,0	700,00 700,00 345,00 3,120,00 2,300,00 49,87 492,00 140,50 25,00 998,00 1,350,00 417,00 47,80	700,000 345,000 2,850,000 2,009,000 26,250 447,000 25,000 249,000 1,281,000 687,000 393,000 45,400	700,000 345,000 2,700,000 1,950,000 26,250 426,000 25,000 924,000 1,246,000 652,000	700,000	700,000 345,000 2,610,000 1,875,000 26,250 414,000 50,000	700,000 345,000 2,580,000 1,911,000 28,875 412,000 50,000	24,100,000 700,000 345,000 2,565,000 1,860,000 28,875 411,000 NONE 50,000	A. Turbine generator unit B. Turbine generator erection C. Reserve exciter D. Turbine foundation 2. Condensers A. Shells and accessories B. Dry vacuum pumps C. Tubes D. Steam jet air equipment E. Krection F. Deserstion - bot well of cond. G. L-P heaters in exhaust stack 3. Circulating Water System A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall
D. Turbine foundation 345,000	3,120,00 2,300,00 49,87 492,00 140,50 25,00 25,00 1,350,00 1,350,00 417,00 47,80	2,850,000 2,009,000 26,250 447,000 25,000 25,000 249,000 1,281,000 687,000 393,000 45,400	345,000 2,700,000 1,950,000 26,250 426,000 25,000 924,000 1,246,000 652,000	345,000 2,640,000 1,905,000 26,230 417,000 50,000	2,610,000 1,875,000 26,250 414,000 50,000	2,580,000 1,911,000 28,875 412,000 50,000	2,565,000 1,860,000 28,875 411,000 NONE 50,000	D. Turbine foundation 2. Condensers A. Shells and accessories B. Dry vacuum pumps C. Tubes D. Steam jet air equipment E. Krection F. Deaeration - hot well of cond. G. L-P heaters in exhaust stack 3. Circulating Water System A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall
A. Shells and accessories B. Dry vacuum pumps C. Tubes D. Steam jet air equipment E. Erection P. Deasterstion - hot well of cond. G. L-P heaters in exhaust stack 3. Circulating Water System A. Structures B. Superstructure B. Superstructure B. Superstructure B. Superstructure B. Superstructure B. Superstructure B. Superstructure B. Superstructure C. Steel C. Outfall B. Crit house equipment C. Steven wash piping C. Circulating water piping C. Circulating water piping C. Circulating water piping C. Circulating water piping C. Circulating water piping C. Circulating water piping D. Circulating water piping D. Circulating water piping C. Steel C. Steel C. Steel C. Steel C. Steel C. Circulating water piping D. Circulating water piping D. Circulating water piping C. Circulating wat	2,300,00 49,87 492,00 140,50 25,00 998,00 1,350,00 417,00 417,00 47,80	2,009,000 26,250 447,000 25,000 25,000 949,000 1,281,000 687,000 393,000 45,400	1,950,000 26,250 426,000 25,000 25,000 924,000 1,246,000 652,000	1,905,000 26,230 417,000 50,000 912,000	1,875,000 26,250 414,000 50,000	1,911,000 28,875 412,000 50,000	1,860,000 28,875 411,000 NONE	A. Shells and accessories B. Dry vacuum pumps C. Tubes D. Steam jet air equipment E. Brection F. Deaeration - hot well of cond. G. L-P heaters in exhaust stack 3. Circulating Water System A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall
C. Tubes D. Steam jet air equipment P. Deasterstion - hot well of cond. G. L-P heaters in exhaust stack 3. Circulating Water System A. Structures D. Superstructure D. Supers	9, 87 492,00 140,50 25,00 998,00 1,350,00 1,350,00 417,00 47,80	26,250 447,000 25,000 249,000 1,281,000 687,000 393,000 45,400	26,250 426,000 25,000 25,000 924,000 1,246,000 652,000	26, 2\$0 417,000 50,000 912,000	26,250 414,000 50,000 908,000	28,875 412,000 50,000 905,000	28,875 411,000 NONE 50,000	C. Tubes D. Steam jet air equipment E. Brection F. Deaeration - hot well of cond. G. L-P heaters in exhaust stack 3. Circulating Water System A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall
G. L-P heaters in exhaust stack 50,000 50,000 50,000 25,000 25,000 25,000 25,000 3. Circulating Water System A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 902,000 905,000 908,000 912,000 924,000 949,00 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall B. Crib house equipment (erected) 1. Traveling acreens 2. Screen wash piping 4. Chlorination equipment 5. Chlorine handling C. Circulating water pumps 1. Fumps 618,000 27,000 372,000 374,000 380,000 393,00 2. Notors 368,000 370,000 372,000 374,000 380,000 393,00 3. Erection 43,000 43,200 43,300 43,500 44,200 45,40 4. Feed Water Heaters A. L-P closed heaters 712,500 425,500 391,500 122,500 119,00 D. Insulation 1. Closed heaters 37,400 375,600 375,600 347,400 340,500 268,000 20,000 19,70 B. H-P closed heaters 371,400 375,600 377,600 347,400 340,500 268,000 20,000 19,70 E. Structural work 1. For closed heaters 42,000 31,500 21,000 10,500 10,500 2. Ped earators 80,700 76,900 74,100 72,000 601,000 59,20 5. Boiler Feed Pumps A. Pumps and base plates 514,000 484,000 440,000 422,000 45,300 E. Fluid drive 633,000 333,000 333,000 333,000 333,000 333,000 333,000 333,000 333,000 333,000 333,000 520,000 E. Foundation for pumps 11,100 10,500 9,900 9,600 9,200 9,000 9,000	998,000 253,000 1,350,000 417,000 47,800 171,000	949,000 232,000 1,281,000 687,000 393,000 45,400	924,000 221,000 1,246,000 652,000	912,000	908,000	905,000	902,000	G. L-P heaters in exhaust stack 3. Circulating Water System A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal weil 5. Discharge flume 6. Outfall
A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscelianeous 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall 8. Crib house equipment (erected) 1. Traveling acreens 2. Screen wash pumps 3. Screen wash pumps 4. Chlorination equipment 5. Chlorine heading 6. Circulating water pumps 1. Fumps 1. Fumps 2. Motors 3. Erection 4. Feed Water Heaters A. L-P closed he	253,00 1,350,00 753,00 417,00 47,80	232,000 1,281,000 687,000 393,000 45,400	221,000 1,246,000 652,000	216,000		-		A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal weil 5. Discharge flume 6. Outfall
2. Screen wash pumps 3. Screen wash piping 4. Chlorination equipment 5. Chlorine handling C. Circulating water piping 1.215,000 1,219,000 1,224,000 1,229,000 1,246,000 1,281,00 D. Circulating water piping 1. Fumps 2. Metors 368,000 370,000 372,000 374,000 380,000 393,00 3. Erection 43,000 43,200 43,300 43,500 44,200 45,400 4. Feed Water Heaters A. L-P closed heaters A. L-P closed heaters 712,500 425,500 391,500 186,000 122,500 C. Deaerating heater 371,400 357,600 347,400 340,500 268,000 265,00 D. Insulation 1. Closed heaters 38,200 23,800 19,600 10,500 3,000 2. Deaerators 27,300 26,300 25,600 25,000 20,000 19,70 E. Structural work 1. For closed heaters 42,000 31,500 21,000 10,500 3,000 2. Por deaerators 80,700 76,900 74,100 72,000 60,000 59,20 5. Boiler Feed Pumps A. Pumps and base plates 514,000 484,000 454,000 440,000 422,000 415,000 B. Fluid drive 633,000 333,000 333,000 333,000 333,000 241,000 C. Motors 770,000 705,000 667,000 632,000 601,000 582,00 D. Erection 52,600 50,100 47,500 663,000 601,000 582,00 D. Erection 52,600 50,100 47,500 663,000 44,700 44,20 E. Foundation for pumps 11,100 10,500 9,900 9,600 9,200 9,00	1,350,000 753,000 417,000 47,800	1,281,000 687,000 393,000 45,400	1,246,000 652,000		214,000	213,000		
C. Circulating water piping D. Circulating water pumps 1. Pumps 2. Motors 368,000 370,000 372,000 374,000 374,000 380,000 393,00 43,500 44,200 45,40 4. Feed Water Heaters A. L-P closed heaters 771,000 A 1,20,000 A 1	753,000 417,000 47,800	687,000 393,000 45,400	652,000	1,229,000			212,000	 Screen wash pumps Screen wash piping Chlorination equipment
2. Motors 368,000 370,000 372,000 374,000 380,000 393,00 393,00 3. Erection 43,000 43,200 43,300 43,500 44,200 65,40 45,40 43,200 43,500 43,500 44,200 65,40 45,40 43,200 43,500 43,500 44,200 65,40 45,40 43,200 43,500 391,500 186,000 122,500 119,00 E. Feutlon 1. Closed heaters 712,500 425,500 391,500 186,000 122,500	417,000 47,800 171,000	393,000 45,400			1,224,000	1,219,000	1,215,000	C. Circulating water piping
3. Erection 43,000 43,200 43,300 43,500 44,200 45,400 4. Feed Water Heaters A. L-P closed heaters 371,000 375,000 226,500 230,000 112,500 119,00 B. H-P closed heaters 712,500 425,500 391,500 186,000 122,500 C. Deaerating heater 371,400 357,600 347,400 340,500 268,000 265,00 D. Insulation 1. Closed heaters 38,200 23,800 19,600 10,500 3,000 2. Deaerators 27,300 26,300 25,600 25,000 20,000 19,70 E. Structural work 1. For closed heaters 42,000 31,500 21,000 10,500 10,500 2. For deaerators 80,700 76,900 74,100 72,000 60,000 59,20 5. Boiler Feed Pumps A. Pumps and base plates 514,000 484,000 454,000 440,000 422,000 415,00 B. Fluid drive 633,000 333,000 333,000 333,000 333,000 241,00 C. Motors 770,000 705,000 667,000 632,000 601,000 582,00 D. Erection 52,600 50,100 47,500 46,300 44,700 44,20 E. Foundation for pumps 11,100 10,500 9,900 9,600 9,200 9,00	47,80	45,400		635,000				
4. Feed Water Heaters A. L-P closed heaters 377,000 375,000 226,500 230,000 112,500 119,000 B. H-P closed heaters 712,500 425,500 391,500 186,000 122,500 C. Deaerating heater 371,400 357,600 347,400 340,500 268,000 265,00 D. Insulation 1. Closed heaters 38,200 23,800 19,600 10,500 3,000 2. Deaerators 27,300 26,300 25,600 25,000 20,000 19,70 E. Structural work 1. For closed heaters 42,000 31,500 21,000 10,500 10,500 2. Por deaerators 80,700 76,900 74,100 72,000 60,000 59,20 5. Boiler Feed Pumps A. Fumps and base plates 514,000 484,000 454,000 440,000 422,000 415,00 B. Fluid drive 633,000 333,000 333,000 333,000 333,000 241,000 C. Motors 770,000 705,000 667,000 652,00 601,000 582,00 D. Erection 52,600 50,100 47,500 46,300 44,700 442,20 E. Foundation for pumps 11,100 10,500 9,900 9,600 9,200 9,00	171,00	·						
A. L-P closed heaters 377,000 375,000 226,500 230,000 112,500 119,000 B. H-F closed heaters 712,500 425,500 391,500 186,000 122,500 C. Deaerating heater 371,400 357,600 347,400 340,500 268,000 255,000 D. Insulation 1. Closed heaters 38,200 23,800 19,500 10,500 3,000 2. Deaerators 27,300 26,300 25,600 25,000 20,000 19,700 E. Structural work 1. For closed heaters 42,000 31,500 21,000 10,500 10,500 2. For deaerators 80,700 76,900 74,100 72,000 60,000 59,20 5. Boiler Feed Pumps A. Pumps and base plates 514,000 484,000 454,000 440,000 422,000 415,00 B. Fluid drive 633,000 333,000 333,000 333,000 333,000 241,00 C. Motors 770,000 705,000 667,000 622,000 601,000 582,00 D. Erection 52,600 50,100 47,500 46,300 44,700 44,700 E. Foundation for pumps 11,100 10,500 9,900 9,600 9,200 9,00	171,00	114 44-	44,200	43,500	43,300	43,200	43,000	
B. H-F closed heaters 712,500 425,500 391,500 186,000 122,500	171,00	110 000	112 500	230 000	226 500	375 000	377 000	· · · · · · · · · · · · · ·
C. Deaerating heater 371,400 357,600 347,400 340,500 268,000 265,00 D. Insulation 1. Closed heaters 38,200 23,800 19,600 10,500 3,000 2. Deaerators 27,300 26,300 25,600 25,000 20,000 19,70 E. Structural work 1. For closed heaters 42,000 31,500 21,000 10,500 10,500 2. For deaerators 80,700 76,900 74,100 72,000 60,000 59,20 5. Boiler Feed Pumps A. Pumps and base plates 514,000 484,000 454,000 440,000 422,000 415,000 B. Fluid drive 633,000 333,000 333,000 333,000 241,000 C. Motors 770,000 705,000 667,000 632,000 601,000 582,000 D. Erection 52,600 50,100 47,500 663,000 44,700 44,20 E. Foundation for pumps 11,100 10,500 9,900 9,600 9,200 9,00								
2. Deserators 27,300 26,300 25,600 25,000 20,000 19,70 E. Structural work 1. For closed heaters 2. For deserators 80,700 76,900 74,100 72,000 60,000 59,20 5. Boiler Feed Pumps A. Fumps and base plates 514,000 484,000 454,000 440,000 422,000 415,00 B. Fluid drive 633,000 333,000 333,000 333,000 241,00 C. Motors 770,000 705,000 667,000 692,000 601,000 582,00 D. Erection 52,600 50,100 47,500 46,300 44,700 44,20 E. Foundation for pumps 11,100 10,500 9,900 9,600 9,200 9,00		265,000	268,000	340,500	347,400	357,600	371,400	C. Desersting heater D. Insulation
E. Structural work 1. For closed heaters 2. For deaerators 80,700 76,900 74,100 72,000 60,000 59,20 5. Boiler Feed Pumps A. Pumps and base plates 514,000 484,000 454,000 440,000 422,000 415,00 B. Fluid drive 633,000 333,000 333,000 333,000 241,00 C. Motors 770,000 705,000 667,000 622,000 601,000 582,00 D. Erection 52,600 50,100 47,500 46,300 44,700 44,20 E. Foundation for pumps 11,100 10,500 9,900 9,600 9,200 9,00								
1. For closed heaters 42,000 31,500 21,000 10,500 10,500 2. For dearaters 80,700 76,900 74,100 72,000 60,000 59,20 5. Boller Feed Pumps A. Fumps and base plates 514,000 484,000 454,000 440,000 422,000 415,00 B. Fluid drive 633,000 333,000 333,000 333,000 241,00 C. Motors 770,000 705,000 667,000 632,000 601,000 582,00 D. Exection 52,600 50,100 47,500 46,300 44,700 44,20 E. Foundation for pumps 11,100 10,500 9,900 9,600 9,200 9,00		19,700	20,000	25,000	25,600	26,300	27,300	
2. For deaerators 80,700 76,900 74,100 72,000 60,000 59,20 5. Boller Feed Pumps A. Pumps and base plates 514,000 484,000 454,000 440,000 422,000 415,00 B. Fluid drive 633,000 333,000 333,000 333,000 333,000 241,00 C. Motors 770,000 705,000 667,000 622,000 601,000 582,00 D. Erection 52,600 50,100 47,500 46,300 44,700 44,20 E. Foundation for pumps 11,100 10,500 9,900 9,600 9,200 9,00			10 500	10.500	21.000	37.500	42.000	
5. Boller Feed Pumps A. Pumps and base plates B. Fluid drive 633,000 333,000 333,000 333,000 333,000 333,000 333,000 333,000 333,000 333,000 333,000 333,000 333,000 333,000 333,000 333,000 333,000 341,00 652,000 65		59,200				76,900		
A. Pumps and base plates 514,000 484,000 454,000 440,000 422,000 415,000 514 615,000 613,000 333,000 333,000 333,000 333,000 241,000 610,000 652,000 601,000 582,000 601,000 582,000 601,000 582,000 601,000 582,000 610,000 582,000 610,000 582,000 610,000 582,000 610,000 582,000 610,000 6							•	. Roller Feed Pumps
B. Fluid drive 633,000 333,000 333,000 333,000 241,00 C. Motors 770,000 705,000 667,000 632,000 601,000 582,00 D. Erection 52,600 50,100 47,500 46,300 44,700 44,20 E. Foundation for pumps 11,100 10,500 9,900 9,600 9,200 9,00	405,00	415,000	422,000	440,000	454,000	484,000	514,000	
D. Erection 52,600 50,100 47,500 46,300 44,700 44,20 E. Foundation for pumps 11,100 10,500 9,900 9,600 9,200 9,00		241,000			333,000	333,000		
R. Foundation for pumps 11,100 10,500 9,900 9,600 9,200 9,00			601,000	632,000	667,000	705,000	770,000	
							32,000 11 100	
	0,00	9,000	9,200	3,000	9,900	10,500	11,100	
6. Condensate Pumps		87,000	81 000	87 000	85 000	133,000	134,000	
		39,800						
		13,100						
7. Piping and Insulation A. Extraction steam	147.60	951 700	250 200	455 700	560 800	621 900	7 720 200	
b. Heater vents and drains		251,700				-	1	
C. Feed water piping 483,000 431,000 319,000 294,000 294,000 174,00 D. Condensate piping 1. From condensate pumps	359,000	174,000	294,000	294,000	319,000	431,000	483,000	D. Condensate piping
through L-P heaters. 188,700 188,700 166,000 165,000 153,000 153,000 2. To descrator and B.F. pump suction		153,000	153,000	166,000	166,000	188,700	188,700	through L-P heaters. 2. To descrator and B.F.
	28,500	28,500	35,500	35,500	35,500	35,500	45,200	
	•	210,000	•	1				. Demineralizing Equipment
9. Electrical 368,200 356,500 344,700 338,400 331,000 332,00	279,000	332,000	331,000	338,400				. Electrical
	27 565 00	27 122 950	27 262 652					
Total Items 1-10 39,342,475 38,509,675 37,927,450 37,587,550 37,262,650 37,132,85			J/,Z0Z,030	:				
	11 974 000							
		11,874,000	11,874,000		49,801,450			
	49,439,97	11,874,000 49,006,850	11,874,000 49,136,650		700 000			. Fining In Contain 7
Grand Total 52,345,475 51,172,675 50,591,450 50,250,550 49,925,650 49,778,850	49,439,975 774,000	11,874,000 49,006,850 772,000	11,874,000 49,136,650 789,000	789,000	790,000	789,000	1,129,000	

SUMMARY OF COST DATA
1400 PSIA, 787 F THROTTLE STRAM
(200 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement		6	5	4	3	2	11
1. Turbine Generator and Accessor	ies				200 000	22 200 000	22 200 000
A. Turbine generator unit	23,300,000 700,000	23,300,000 700,000	700,000	23,300,000 700,000	700,000	23,300,000 700,000	23,300,000 700,000
B. Turbine generator erection C. Reserve exciter	< \ 	700,000	,	CONSTANT	+		
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000	345,000
2. Condensers	٦				į		
A. Shells and accessories B. Dry vacuum pumps	2,430,000	2,445,000	2,460,000	2,505,000	2,550,000	2,670,000	2,940,000
C. Tubes	1,731,000	1,770,000	1,785,000	1,806,000	1,845,000	1,970,000	2,159,000
D. Steam jet alr equipment	28,875	28,875	26,250	26,250	26,250 409,000	26,250 421,000	49,875 461,000
E. Erection	390,000 NONE	399,000	400,000	402,000	409,000		132,300
F. Deseration - hot well of cond.	10112					ŕ	
G. L-P heaters in exhaust stac	k 50,000	50,000	50,000	50,000	25,000	25,000	25,000
3. Circulating Water System							
A. Structures	7						
1. Crib house a. Substructure	- 1				ļ		
b. Superstructure	1				į		
c. Steel	275 200	070 000	002 000	000 000	899,000	918,000	963,000
d. Miscellaneous	875,000	879,000	883,000	889,000	899,000	910,000	903,000
 Dredging Intake flume or forebay 	į				:		
4. Seal well							
Discharge flume							
6. Outfall	.≅				1		
 B. Crib house equipment (erect Traveling screens 	ea) [
2. Screen wash pumps	200,000	202,000	204,000	206,000	210,000	219,000	238,000
Screen wash piping	م				:		
 Chlorination equipment Chlorine handling]						
C. Circulating water piping	1,178,000	1,183,000	1,189,000	1,197,000	1,211,000	1,239,000	1,301,000
D. Circulating water pumps			507.000		618,000	645,000	705,000
1. Pumps	586,000 355,000	591,000 357,000	597,000 359,000	605,000 362,000	367,000	377,000	400,000
 Motors Erection 	41,700	41,800	42,100	42,400	42,800	43,800	46,100
4. Feed Water Heaters	•			•			
A. L-P closed heaters	347,500	345,000	212,000	215,000	106,000	111,000	141.000
B. H-P closed heaters	651,000	392,000	361,500	173,000	116,000 256,400	254,000	161,000
C. Deserating heater	350,400	339,000	264,000	259,600	230,400	234,000	
D. Insulation l. Closed heaters	30,000	20,200	16,100	9,500	2,700		
2. Deserators	25,700	24,900	19,600	19,200	19,000	18,800	
E Structural work	42,000	31,500	21,000	10,500	10,500		
 For closed heaters For deaerators 	74,900	71,900	58,800	57,400	56,400	55 ,6 00	
			•	7	!		
 Boiler Feed Pumps A. Pumps and base plates 	469,000	446,000	421,000	409,000	394,000	389,000	382,000
B. Fluid drive	333,000	333,000	333,000	241,000	241,000	241,000	241,000 534,000
C. Motors	682,000 48,700	631,000 46,800	600,000 44,700	572,000 43,700	542,000 42,400	532,000 42,000	41,400
D. Erection E. Foundation for pumps	10,200	9,700	9,200	8,900	8,600	8,500	8,300
		- •					
6. Condensate Pumps A. Pumps	122,000	121,000	78,000	80,000	76,000	80,000	
B. Motors	71,800	71,500	45,200	46,000	35,200 12,100	37,000 12,500	
C. Erection	12,900	12,800	12,400	12,500	12,100	12,500	
. Piping and Insulation	_				1		
A. Extraction steam	726,900	631,800	539,700	447,600	358,200	251,700	147,600
B. Heater vents and drains C. Feed water piping	483,000	431,000	319,000	294,000	294,000	174,000	359,000
D. Condensate piping	–				1		
 From condensate pumps 	188,700	188,700	166,000	166,000	141,100	141,100	
through L-P heaters.	} 100,700	200,700	200,000	200,000	i	•	
To deserator and B.F. pump suction							
E. Main steam	107,300	97,000	97,000	97,000	97,000	97,000	97,000
3. Demineralizing Equipment	230,000	217,000	208,000	203,000	198,000	195,000	195,000
and Condensate Storage Tanks			-				
9. Electrical	347,200	337,500	328,000	323,000	317,700	317,800	265,800
O. Turbine Room Building							• • • •
Total Items 1-10	37,564,775	37,090,975	36,494,550	36,123,550	35,872,350	35,857,050	36,197,375
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	49,438,775	48,964,975	48,368,550	47,997,550	47,746,350	47,731,050	48,071,375
	1,266,000	1,003,000	1,003,000	1,001,000	1,001,000	986,000	997,000
 Piping In Containment Vessel Grand Total 	50,704,775	49,967,975	49,371,550	48,998,550	48,747,350	10 717 050	49,068,375

SUMMARY OF COST DATA
1400 PSIA, 887 F THROTTLE STEAM
(300 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

1. Turbine Generator and Accessories 2. A. Turbine generator unit 2. Turbine generator exection C. Reserve exciter D. Turbine generator exection C. Reserve exciter D. Turbine foundation 345,000 345,									
A. Turbine generator unit B. Turbine generator exection D. Turbine generator exection D. Turbine generator exection D. Turbine generator exection D. Turbine generator exection D. Turbine generator A. Shells and accessories A. Shells and accessories A. Shells and accessories A. Shry vacuum pumps C. Tubes D. Steam jet air equipment S. Steam jet air equipment C. Tubes D. Steam jet air equipment MONE F. Descretion - hot well of cond G. LP heaters in exhaust stack A. Structures A. Structures A. Structures A. Structures A. Structures A. Structures A. Structures A. Structures A. Structures A. Structures A. Structures A. Structures A. Structures A. Structures A. Structures C. Steel A. Structures B. Superstructure C. Steel A. Structures C. Steel A. Structures A. Stanl well S. Discharge flume G. Outfall S. Discharge flume G. Outfall S. Discharge flume G. Outfall S. Discharge flume G. Outfall S. Discharge flume G. Ottrulating water system C. Circulating water system L. Turbing water system L. Turbing water system C. Circulating water system L. Turbing water system L. Turbing water system L. Turbing water system A. Structures L. Turbing water system C. Circulating water system L. Turbing water system	_	Heater Arrangement	7	6	5		3	2	1
8. Turbine generator erection C. Reserve exerter D. Turbine foundation 345,000	1.		23 400 000	23 400 000	23 600 000	22 400 000	23 400 000	22 600 000	22 600 000
C. Reserve exciter D. Turbina frommation 345,000 345,000 345,000 345,000 345,000 345,000 345,000 345,000 345,000 345,000 345,000 345,000 345,000 345,000 345,000 345,000 345,000 345,000 345,000 2,200,000 2,200,000 2,200,000 2,200,000 2,200,000 2,200,000 2,200,000 2,200,000 2,200,000 2,200,000 2,200,000 2,200,000 2,200,000 2,200,000 2,200,000 2,200,000 372,000 372,000 372,000 372,000 372,000 372,000 372,000 372,000 382,000 384,000 414,000 414,000 428,000 372,000 372,000 372,000 372,000 382,000 384,000 414,000 414,000 428,000 382,000 382,000 384,000 414,000 428,000 382,000 382,000 384,000 414,000 414,000 428,000 428,000 857,000 868,000 891,000 926 414,000 4						700,000			700,000
2. Condensers 3. Bry vacuus pumps 1. Seed part agreement 2. 2,86,000 2. 2,80,000 2. 310,000 2. 325,000 2. 400,000 2. 710.000 1. 155,000 1. 175,		C. Reserve exciter				Constant			>
A. Shelle and accessories 3. Dry vaccumpumps C. Tubes S. Steem fit aftr equipment S. Steem fit aftr equipment S. Steem fit aftr equipment F. Description - hot well of cond G. LP heaters in exhaust stack S. Circulating Water System A. Structures C. Steem fit aftree fit and steem S. Structures C. Steem fit aftree fit and steem S. Structures C. Steem fit aftree fit and steem S. Structures C. Steem wash pumps A. Circulating water piping C. Circulat		D. Turbine foundation	345,000	345,000	345,000	345,opo	345,000	345,000	345,000
3. Dry Vacuum pumps C. Tubes D. Steam jet air equipment D. Steam jet air equipment S. Execution F. Control of the steam jet air equipment S. Execution F. Control of the steam jet air equipment F. Control of the steam jet air equipment F. Control of the steam jet air equipment F. Control of the steam jet air equipment F. Control of the steam jet air equipment S. Execution S. Control of the steam jet air equipment S. Control of the steam jet air eq	2.					174			
C. T. C. T.			2,265,000	2,280,000	2,310,000	2,325,000	2,400,000	2,520,000	2,715,000
E. Execution - hot well of Cond Call - Phasters in exhaust stack 50,000 50,000 50,000 50,000 25,000									1,956,000
F. Descration - hot well of cond G. 1P heaters in exhaust stack 50,000 50,000 50,000 50,000 25,000 25,000 25,000 25 A. Structures A. Structures 1. Orth house A. Substructure A. Miscallancous 2. Dredging 3. Intake flume or forebay A. Structure A. Structures A. Substructure A. Structures A. Substructure A. Miscallancous 2. Dredging 3. Intake flume or forebay A. Sal well 5. Olicharge flume B. Orth house eauthpent (Aracted) C. Greuiting water piping C. Greuiting water piping A. Chirofination equipment D. Chirolination equipment D. Chirolination equipment D. Chirolination equipment D. Chirolination equipment D. Chirolination equipment D. Chirolination equipment D. Chirolination equipment D. Page water piping D. Chirolination equipment D. Chirolination equipment D. Page water piping D. Chirolination equipment D. Page water piping D. Chirolination equipment D. Page water piping D. Pred Water Hasters A. L.P closed heaters A. Closed heater			28,875			26,250			49,875
Cond C. 1-P heaters in exhaust stack 50,000 50,000 50,000 50,000 25,000 25,000 25,000 25 Circulating Water System A. Structures b. Superstructure c. Steel Inscous 2. Dredging 3. Incake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall 8. Crib house equipment (bracted) 1. Traveling screens 5. Chlorine handling C. Circulating water pumps 1. Traveling screens 5. Chlorine handling C. Circulating water pumps 1. Thungs 2. Notons 340,000 341,000 341,000 341,000 352,000 353,000 353,000 35. Criculating water pumps 1. Thungs 2. Notons 340,000 341,000 341,000 341,000 342,000 352,000 353,000 353,000 35. Criculating water pumps 1. Thungs 3. Erection 40,200 40,200 40,500 40,500 40,500 352,000 353,000 353,000 35. Criculating water pumps 1. Thungs 3. Erection 40,200 40,200 40,500 341,000 341,000 342,500 352,000 353,000 353,000 35. Criculating water pumps 1. Thungs 3. Erection 40,200 40,200 40,500 40,500 40,500 352,000 353,000 353,000 35. Criculating water pumps 1. Thungs 3. Erection 40,200 40,200 40,500 40,				3/2,000	3/8,000	382,000	384,000	414,000	428,000 121,900
3. Circulating Water System A. Structures 1. Substructure 2. Superstructure 2. Streed 3. Lintake films or forebay 3. Lintake films 4. Lintake films or forebay 3. Lintake films or forebay 3. Lintake films or forebay 3. Lintake films or forebay 3. Lintake films or forebay 3. Lintake films or forebay 3. Lintake films or forebay 3. Lintake films or forebay 3. Lintake films or forebay 3. Lintake films or forebay 3. Lintake films or forebay 3. Lintake films or forebay 3. Lintake films or forebay 3. Lintake films or forebay 3. Lintake films or forebay 3. Lintake films or forebay 3. Lintake films or forebay 3. Lintake films 4. Lintake films or forebay 3. Lintake films or forebay 3. Lintake films films 3. Lintake films films 3. Lintake films films 3. Lintake films films 3. Lintake films films 3. Lintake films films 3. Lintake films films 3. Lintake films films 3. Lintake films films 3. Lintake films films 3. Lintake films films 3. Lintake films films 3. Lintake films films 3. Lintake f									
A. Structures 1. Grib house a. Substructure b. Superstructure c. Steel 1. Grib house or forebay 4. Seal well 5. Discharge flume 6. Outfall 1. Traveling screems 2. Screen wesh pumps 3. Criculating water pumps 1. Fumps 1. Pumps 2. Motors 3. Strection 3. Strection 4. Q20 4. Good 3. Strection 4. Clore landsharer 5. Glorian handling 6. Circulating water pumps 1. Fumps 2. Motors 3. Strection 4. Clore landsharer 5. Glorian handling 6. Circulating water pumps 1. Fumps 2. Motors 3. Strection 4. Q20 4. Good 3. Strection 4. LP closed heaters 607,000 366,500 366,500 364,000 313,000 313,000 313,000 313,000 313,000 313,000 313,000 313,000 313,000 314,000 314,000 315		G. L-P heaters in exhaust stack	50,000	50,000	50,000	50,000	25,000	25,000	25,000
4. Seal well 5. Discharge flume 6. Outfall 8. Cith house equipment (arected) 1. Traveling screens 2. Screen wash pumps 3. Screen wash pumps 4. Chlorination aquipment 5. Chlorinat inauding 6. Citroliating water pumps 1. Fumps 1.	3.	A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging	, 847,000	849,000	851,000	857,000	868,000	891,000	926,000
C. Ctrculating water piping D. Circulating water pumps 1. Pumps 2. Motors 3. Erection 40,200 549,000 553,000 532,000 536,000 5		4. Seal well 5. Discharge flume 6. Outfall B. Crib house equipment (brected) 1. Traveling screens 2. Screen wash pumps 3. Screen wash piping 4. Chlorination equipment	S 188,000	189,000	190,000	193,000	198,000	207,000	222,000
1. Pumps 2. Motors 340,000 341,000 343,000 346,000 352,000 608,000 653 3. Erection 40,200 40,300 40,500 40,800 41,300 42,500 44. 4. Feed Water Heaters		C. Circulating water piping	1,138,000	1,140,000	1,143,000	1,153,000	1,168,000	1,200,000	1,249,000
2. Notors 3. Erection 40,000 341,000 343,000 346,000 341,000 41,300 42,500 44 4. Feed Water Heaters A. LP closed heaters 607,000 366,500 382,000 198,000 103,000 113,500 113			547.000	549,000	553,000	561.000	576,000	608,000	655,000
4. Feed Water Heaters A. L-P closed heaters B. H-P closed heaters B. H-P closed heaters C. Deaerating heater C. Deaerating heater D. Insulation 1. Closed heaters 267,000 259,400 254,000 250,000 247,000 245,600 151 26. Deaerators 19,900 19,200 10,700 18,400 18,200 18,000 2. Deaerators 19,900 19,200 10,700 18,400 18,200 18,000 2. For deaerators 19,900 19,200 10,700 10,500 2. For deaerators 59,800 57,300 55,500 54,400 53,400 53,400 53,000 5. Boiler Feed Pumps A. Pumps and base plates B. Fluid drive 333,000 333,000 333,000 241,000 241,000 241,000 241,000 241,000 241,000 241,000 241,000 241,000 241,000 241,000 241,000 241,000 241,000 241,000 241,000 241,000 241,000 241,000 374,000 370,000 376,000 3776,000 3776,000 3776,000 3776,000 3776,000 37776,000 37776,000 377777777777777777777777777777			340,000	341,000	343,000	346,000	352,000	363,000	381,000
A. L-P closed heaters 607,000 322,000 198,000 200,000 103,000 104,500		3. Erection	40,200	40,300	40,500	40,800	41,300	42,500	44,200
B. H-F closed heaters									
C. Deaerating heater D. Insulation 1. Closed heaters 2. Deaerators 19,900 19,200 18,700 18,400 18,200 18,000 10,50									151,000
1. Closed heaters 28,200 20,000 14,900 8,900 2,600		C. Deaerating heater							
2. Descrators E. Structural work 1. For closed heaters 2. For descrators 59,800 57,300 55,500 54,400 53,400 53,400 53,000 5. Boiler Feed Pumps A. Pumps and base plates 618,000 610,500 610,500 610,500 618,000 610,500 610,500 610,500 611,000 611,000 611,000 611,000 612,000 611,000 612,000 611,000 612,000 611,000 612,000 611,000 612,000 611,000 612,000 611,000 612,000 613,000			28.200	20.000	14.900	8.900	2.600		
E. Structural work 1. For closed heaters 2. For deserators 59,800 57,300 55,500 54,400 53,400 53,400 53,000 5. Boiler Feed Pumps A. Pumps and base plates B. Pluid drive 333,000 333,000 333,000 333,000 241,000	,								
2. For deaerators 59,800 57,300 55,500 54,400 53,400 53,000 5. Bofler Feed Pumps A. Pumps and base plates 333,000 333,000 241,000 241,000 241,000 241,000 241 C. Motors 618,000 592,000 549,000 526,000 506,000 494,000 47 D. Erection 46,000 44,400 42,600 41,800 40,700 40,000 38 E. Foundation for pumps 9,500 9,100 8,600 8,500 8,200 8,100 7 6. Condensate Pumps A. Pumps B. Motors 66,100 65,700 41,800 42,700 32,900 34,700 C. Erection 12,250 12,200 11,800 11,900 11,600 12,000 Piping and Insulation A. Extraction steam B. Heater vents and drains C. Feed water piping D. Condensate piping 1. From condensate pumps through L-P heaters 2. To deaerator and B.F. pump suction E. Main steam 3. Demineralizing Equipment and Condensate Storage Tanks 9. Electrical 330,800 325,500 313,900 310,200 305,800 306,700 255 Turbine Room Building Total Items 1-10 36,849,725 36,422,975 35,901,350 35,631,250 35,413,450 35,458,450 35,599						1			
5. Boiler Feed Pumps A. Pumps and base plates B. Fluid drive B. Fluid drive B. Fluid drive B. Fluid drive B. Fluid drive B. Fluid drive B. Fluid drive B. Fluid drive B. Fluid drive B. Fluid drive B. Fluid drive B. Fluid drive B. Fluid drive B. Foundation for pumps B. Foundation for pumps B. Motors B. Fumps B. Motors B. Hotors B. Fumps B. Motors B. Fumps B. Motors B. Extraction steam B. Heater vents and drains C. Feed water piping B. Condensate pumps C. Feed water piping B. Condensate pumps C. Feed water piping B. From condensate pumps C. Feed water piping B. Main steam B. Demineralizing Equipment and Condensate Storage Tanks B. Electrical B. Electrical B. Electrical B. Electrical B. Electrical B. Electrical B. Beeter vents B. Boon Building B. Condensate Storage Tanks B. Electrical B. Boon Building B. Beeter vents B. Demineralizing Equipment B. Demineralizing									
A. Pumps and base plates B. Fluid drive 333,000 333,000 241,000 370,000 370,000 241,000 241,000 241,000 241,000 241,000 241,000 241,000 241,000 241,000 241,000 370,00			39,000	57,500	35,500	34, 40	33,400	55,000	
B. Fluid drive C. Motors 618,000 333,000 241,000 241,000 241,000 241,000 241 D. Erection E. Foundation for pumps 9,500 9,100 8,600 44,400 42,600 41,800 40,700 40,000 36 C. Condensate Pumps A. Pumps B. Motors C. Erection 112,000 111,000 72,000 74,000 70,000 75,000 B. Motors C. Erection 12,250 12,200 11,800 11,900 11,600 12,000 Piping and Insulation A. Extraction steam B. Heater vents and drains C. Feed water piping 1. From condensate pumps through LP heaters 2. To deaerator and B.F. pump suction E. Main steam 3. Demineralizing Equipment and Condensate Storage Tanks 9. Electrical 330,800 325,500 313,900 35,631,250 35,413,450 35,458,450 35,599 Total Items 1-10 36,849,725 36,422,975 35,901,350 35,631,250 35,413,450 35,458,450 35,599			437.000	417.000	396,000	387,000	374,000	370,000	360,000
D. Erection					241,000	241,000	241,000	241,000	241,000
E. Foundation for pumps 9,500 9,100 8,600 8,500 8,200 8,100 7 6. Condensate Pumps A. Pumps 112,000 111,000 72,000 74,000 70,000 75,000 B. Motors 66,100 65,700 41,800 42,700 32,900 34,700 C. Erection 12,250 12,200 11,800 11,900 11,600 12,000 Piping and Insulation A. Extraction steam B. Heater vents and drains C. Feed water piping 1. From condensate piping 1. From condensate piping 2. To deaerator and B.F. pump suction E. Main steam 132,300 121,700 111,70					549,000	526,000		494,000	479,000
6. Condensate Pumps A. Pumps B. Motors C. Erection 112,000 111,000 72,000 74,000 70,000 75,000 34,700 8. Motors C. Erection 112,250 12,200 11,800 111,900 11,900 11,600 12,000 7. Piping and Insulation A. Extraction steam B. Heater vents and drains C. Feed water piping D. Condensate piping 1. From condensate pumps through L-P heaters 2. To dearator and B.F. pump suction E. Main steam 3. Demineralizing Equipment and Condensate Storage Tanks 9. Electrical 330,800 325,500 313,900 310,200 350,413,450 350,433,450 35						8,500	8,200	8,100	39,500 7,900
A. Pumps B. Motors C. Erection C. Erection 112,000 111,000 172,000 174,000 74,000 74,000 74,000 32,900 34,700 12,200 11,800 11,900 11,600 12,000 7. Piping and Insulation A. Extraction steam B. Heater vents and drains C. Feed water piping D. Condensate piping 1. From condensate pumps through L-P heaters 2. To dearetator and B.F. pump suction E. Main steam 3. Demineralizing Equipment and Condensate Storage Tanks 9. Electrical 330,800 325,500 313,900 310,200 325,000 311,700 3294,000 3294,000 3294,000 3294,000 3294,000 3294,000 316,700 316,700 111,700		• •	,,,,,,,	,,	-,		-,	-,	
B. Motors C. Frection C. Frect			112,000	111,000	72,000	74,000	70,000	75,000	*
7. Piping and Insulation A. Extraction steam B. Heater vents and drains C. Feed water piping D. Condensate piping 1. From condensate pumps through L-P heaters 2. To deareator and B.F. pump suction E. Main steam 3. Demineralizing Equipment and Gondensate Storage Tanks 9. Electrical 30,800 325,500 319,000 378,000 319,000 343,700 353,100 294,000 294,000 174,000 359 186,700 186,000 149,500 136,700 111,700 111,700 111,700 111,700 111,700 111,700 111,700 111,700 112,700 113,700 113,700 113,700 113,700 121,700 122,000 123,000 1			66,100	65,700	41,800	42,700	32,900	34,700	
A. Extraction steam B. Heater vents and drains C. Feed water piping D. Condensate piping L. From condensate pumps through L-F heaters. 2. To dearator and B.F. pump suction E. Main steam B. Demineralizing Equipment and Condensate Storage Tanks D. Extraction B. Demineralizing Equipment Total Items 1-10 B. Heater vents and drains Tife, 100 612,600 536,100 443,700 353,100 251,700 144,000 353,100 294,000 174,000 355,000 186,000 149,000 149,000 136,700 136,700 111,700 111,700 111,700 111,700 111,700 111,700 111,700 112,700 113	•	3. Erection	12,250	12,200	11,800	11,900	11,600	12,000	
B. Heater vents and drains C. Feed water piping D. Condensate piping 1. From condensate pumps through L-P heaters. 2. To deaerator and B.F. pump suction E. Main steam 132,300 121,700 111,700 111,700 111,700 111,700 113,000 185,000 185 B. Demineralizing Equipment and Condensate Storage Tanks 9. Electrical 330,800 325,500 313,900 305,800 306,700 253 Turbine Room Building Total Items 2-10 36,849,725 36,422,975 35,901,350 35,631,250 35,413,450 35,458,450 35,595						!			
C. Feed water piping D. Condensate piping L. From condensate pumps through L-P heaters. 2. To deaerator and B.F. pump suction E. Main steam 132,300 121,700 111,700 111,700 111,700 111,700 113,000 185,000 B. Denineralizing Equipment and Condensate Storage Tanks 9. Electrical 330,800 325,500 313,900 310,200 305,800 306,700 252 Turbine Room Building Total Items 1-10 36,849,725 36,422,975 35,901,350 35,631,250 35,413,450 35,458,450 35,599			716,100	612,600	536,100	443,700	353,100	251,700	147,600
through L-P heaters 188,700 188,700 166,000 149,500 136,700 136,700	(C. Feed water piping	390,000	378,000	319,000	294,000	294,000	174,000	359,000
E. Main steam 132,300 121,700 111,700 111,700 111,700 111,700 113 Demineralizing Equipment 212,000 202,000 195,000 190,000 186,000 185,000 183 Milectrical 330,800 325,500 313,900 310,200 305,800 306,700 253 Turbine Room Building		through L-P heaters. 2. To deacrator and B.F.	188,700	188,700	166,000	149,500	136,700	136,700	~
3. Demineralizing Equipment 212,000 202,000 195,000 190,000 186,000 185,000 182,000 and Condensate Storage Tanks 9. Electrical 330,800 325,500 313,900 310,200 305,800 306,700 252 1. Turbine Room Building			132,300	121,700	111,700	111,700	111,700	111,700	111,700
9. Electrical 330,800 325,500 313,900 305,800 305,800 306,700 252 0. Turbine Room Building	3. [Demineralizing Equipment				1	186,000	185,000	182,000
Total Items 1-10 36,849,725 36,422,975 35,901,350 35,631,250 35,413,450 35,458,450 35,593	9. ;	Electrical				310,200			252,300
		-							ar ros 075
									35,593,975
Triple delicente door						4			11,874,000
101111111111111111111111111111111111111									47,467,975
1. Piping In Containment Vessel 1,172,000 1,050,000 1,020,000 1,012,000 1,012,000 1,027,000 1,041 (49,895,725 49,346,975 48,795,350 48,517,250 48,299,450 48,359,450 48,508						48,517,250			48,508,975

SUMMARY OF COST DATA 1400 PSIA, 987 F THROTTLE STEAM (400 F SUPERHEAT) 1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement		6		4	3	2	11
1. Turbine Generator and Accessori		23,560,000	23,560,000	23,560,000	23,560,000	23,560,000	23,560,000
A. Turbine generator unit B. Turbine generator erection	23,560,000 700,000	700,000	700,000	700,000	700,000	700,000	700,000
G. Reserve exciter		-		CONSTANT	(
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000	345,000
2. Condensers	,				1		
A. Shells and accessories	2,130,000	2,145,000	2,160,000	2,175,000	2,235,000	2,340,000	2,535,000
B. Dry vacuum pumps C. Tubes	1,572,000	1,585,000	1,595,000	1,610,000	1,605,000	1,692,000	1,830,000
D. Steam jet air equipment	28,875	28,875	26,250	26,250	26,250	26,250	49,875
E. Brection	350,000 None —	353,000	355,000	359,000	366,000	381,000	405,000 114,000
F. Deaeration - hot well of cond.	MONE —					•	224,000
G. L-P heaters in exhaust stack	50,000	50,000	50,000	50,000	25,000	25,000	25,000
3. Circulating Water System							
A. Structures	\neg						
1. Crib house							
a. Substructure b. Superstructure							
c. Steel							
d. Miscellaneous	823,000	826,000	828,000	832,000	841,000	861,000	894,000
2. Dredging	1						
 Intake flume or forebay Seal well 							
5. Discharge flume	-				i		
6. Outfall	_ <						
B. Crib house equipment (erected l. Traveling screens	^{a)}				i		
2. Screen wash pumps	[178,000	179,000	180,000	182,000	185,000	194,000	208,000
Screen wash piping	٢						
4. Chlorination equipment]						
 Chlorine handling Circulating water piping 	1,105,000	1,109,000	1,112,000	1,117,000	1,130,000	1,158,000	1,204,000
D. Circulating water pumps		#10 000	FAR 000	E47 000	540,000	567,000	612,000
1. Pumps	515,000 329,000	519,000 330,000	522,000 331,000	527,000 333,000	540,000 338,000	348,000	365,000
2. Motors 3. Erection	39,100	39,200	39,300	39,500	40,000	41,000	42,700
4. Feed Water Heaters							
A. L-P closed heaters	297,000	298,500	185,000	189,000	94,000	97,000	
B. H-P closed heaters	570,500	346,500	322,000	141,500 240,400	107,500 238,000	237,000	147,000
C. Descrating heater	256,400	249,600	244,400	240,400	236,000	237,000	
D. Insulation 1. Closed heaters	26,000	18,500	13,900	7,700	2,400		
2. Deaerators	19,000	18,400	18,000	17,700	17,500	17,400	
E. Structural work	42,000	31,500	21,000	10,500	10,500		
 For closed heaters For deserators 	56,400	54,200	52,800	51,800	51,000	50,600	
	-			7			
5. Boiler Feed Pumps A. Pumps and base plates	411,000	394,000	375,000	367,000	357,000	354,000	349,000
B. Fluid drive	241,000	241,000	241,000	241,000 489,000	241,000 470,000	192,000 462,000	241,000 466,000
C. Motors	567,000 43,800	530,000 42,400	508,000 40,800	40,200	39,200	39,000	38,600
D. Erection E. Foundation for pumps	9,000	8,600	8,200	8,000	7,800	7,700	7,600
	·						
6. Condensate Pumps A. Pumps	104,000	103,000	68,000	69,000	66,000	70,000	
B. Motors	61,400	61,200	39,200	40,000 11,500	30,900 11,200	32,600 11,600	
C. Erection	11,700	11,700	11,400	12,500	**,***	,500	
7. Piping and Insulation	_			I			
A. Extraction steam B. Heater vents and drains	716,100	612,600	536,100	443,700	353,100	251,700	147,600
C. Feed water piping	390,000	378,000	319,000	281,000	281,000	174,000	359,000
D. Condensate piping	٦	•	-	-			
1. From condensate pumps	174 200	176,200	149,500	149,500	136,700	136,700	
through L-P heaters. 2. To deserator and B.F.	176,200	1,0,200	247,300	147,300	255,700	,.00	
pump suction					1/2	1/0 =00	140 500
E. Main steam	149,500	149,500	149,500	149,500	149,500	149,500	149,500
8. Demineralizing Equipment	199,000	190,000	184,000	180,000	176,000	175,000	176,000
and Condensate Storage Tanks				i			
9. Electrical	316,800	309,700	302,600	299,100	295,300	296,300	244,000
O. Turbine Room Building				1.1. 1.1)			25 01/ 015
Total Items 1-10	36,388,775	35,994,175	35,592,950	35,282,850	35,071,850	34,992,350	35,214,875
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000 47,088,875
Total Turbine Plant Cost	48,262,775 1,337,000	47,868,175	47,466,950	47,156,850 1,180,000	46,945,850 1,180,000	46,866,350	1,182,000
1. Piping In Containment Vessel	49,599,775	1,191,000 49,059,175	1,189,000 48,655,950	48,336,850	48,125,850	48,036,350	48,270,875
Grand Total	-,,,,,,,,	,,-,-	,,			•	

SUMMARY OF COST DATA
1200 FSIA, 567 F THROTTLE STEAM
(SATURATED STEAM)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6 .	5	4	3	2	
1. Turbine Generator and Acces						<u> </u>
A. Turbine generator unit	25,000,000	25,000,000	25,000,000	25,000,000	25,000,000	25,000,000
B. Turbine generator erection			700,000	700,000	700,000	700,000
C. Reserve exciter			CONSTANT	- 		
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000
. Condensers						•
A. Shells and accessories	-			- 1		
B. Dry vacuum pumps	2,205,000	2,235,000	2,250,000	2 280,000	2,380,000	2,550,000
C. Tubes	2,052,000	2,064,000	2,070,000	2,130,000	2,214,000	2,424,00
D. Steam jet air equipment	28,875		28,875	26,250	26,250	49,87
E. Brection	444,000	447,000	453,000	461,000	474,000	513,00
F. Deseration - hot well of	NONE -	,	100,1	102,000	77.77009	152,00
cond.					•	,
G. L-P heaters in exhaust st	ack 50,000	50,000	50,000	25,000	25,000	25,00
. Circulating Water System				1	•	-
A. Structures	$\overline{}$			İ		
1. Crib house				ŀ		
a. Substructure						
b. Superstructure				-		
c. Steel						
d. Miscellaneous	948,000	952,000	957,000	967,000	990,000	1,042,00
Dredging	ſ			'	•	
 Intake flume or foreba 	y İ					
4. Seal well	1			i		
Discharge flume	1			- 1		
6. Outfall				1		
B. Crib house equipment (ere	cted)			Ì		
1. Traveling screens	222 000	227 222	****	212 222	450.000	
Screen wash pumps	232,000	234,000	236,000	240,000	250,000	272,00
3. Screen wash piping	[i		
4. Chlorination equipment				i		
5. Chlorine handling	1,281,000	1 195 000	1,294,000	1 207 000	1 220 000	1 (11 00
C. Circulating water piping D. Circulating water pumps	1,201,000	1,286,000	1,294,000	1,307,000	1,339,000	1,411,00
1. Pumps	686,000	692,000	699,000	712,000	743,000	813,00
2. Motors	392,000	395,000	397,000	402,000	413,000	440,00
3. Erection	45,400	45,600	45,800	46,300	47,500	50,10
	•	•				
Feed Water Heaters	494 E00	200 000	204 500	1.62.000	151 000	
A. L-P closed heaters	486,500	290,000 503,500	296,500	143,000	151,000	
B. H-P closed heaters C. Deaerating heater	538,000 397,500	384,000	240,500 371,400	204,000 361,500	354,000	207,00
D. Insulation	377,300	304,000	372,400	302,300	334,000	
1. Closed heaters	31,400	24,000	14,000	6,000		
2. Deserators	29,600	28,400	27,300	26,600	26,100	
E. Structural work	,	,	,	,	,	
1. For closed heaters	31,500	21,000	10,500	10,500		
2. For deaerators	88,600	84,100	81,000	77,900	76,200	
Boiles Read Burns			7	1 -	•	
Boiler Feed Pumps A. Pumps and base plates	543,000	492,000	467,000	437,000	423,000	408,00
B. Fluid drive	333,000	333,000	241,000	241,000	241,000	241,00
C. Motors	658,000	630,000	582,000	548,000	521,000	520,00
D. Erection	52,300	48,100	46,000	43,400	42,400	41,10
E. Foundation for pumps	12,700	11,600	11,000	10,300	10,000	9,70
	,-		-,			- ,
Condensate Pumps	171 000	110 000	114 000	90.000	go nnn	
A. Pumps B. Motors	171,000 155,900	110,000 59,400	114,000 61,400	80,000 36,900	88,000 40,400	
B. Motors C. Erection	14,500	13,300	13,600	12,500	13,200	
	-1,5	20,000	***	12,500	13,100	
Piping and Insulation	_					
A. Extraction steam	603,000	536,400	441,000	381,600	243,000	143,700
B. Heater vents and drains	ا ا	,	•	'	•	•
C. Feed water piping	441,000	441,000	265,000	265,000	160,400	311,000
D. Condensate piping 1. From condensate pumps	290,200	203,500	203,500	185,800	185,800	
through L-P heaters.	290,200	203,500	203,500	185,800	185,800	
2. To deaerator and B.F.		•				
pump suction	}					
E. Main steam	47,500	47,500	42,700	42,700	42,700	42,700
	284,000			1	-	
Demineralizing Equipment	204,000	267,000	254,000	242,000	234,000	233,000
and Caudining						
	364,600	344,600	336,200	326,800	325,000	272,400
Electrical				_ +		
Electrical Turbine Room Building			ገጽ ሐ /ፍ ንፖር	ገደ ነን/ በናበ	38 J32 D40	
Electrical Turbine Room Building Total Items 1-10	39,983,075	39,346,875	38,645,275	38,324,050	38,123,950	
Electrical Turbine Room Building Total Items 1-10 Total Constant Cost	39,983,075 11,874,000	39,346,875 11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Turbine Room Building Total Items 1-10 Total Constant Cost Total Turbine Plant Cost	39,983,075	39,346,875		-1 -		11,874,000
Electrical Turbine Room Building Total Items 1-10 Total Constant Cost	39,983,075 11,874,000	39,346,875 11,874,000	11,874,000	11,874,000	11,874,000	38,216,575 11,874,000 50,090,575 785,000

SUMMARY OF COST DATA
1200 PSIA, 667 F THROTTLE STEAM
(100 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

					<u> </u>	
Heater Arrangement	6	5	. 4	3	2	1
Turbine Generator and Accessorie	24,100,000	24,100,000	24,100,000	24,100,000	24,100,000	24,100,000
A. Turbine generator unit B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	*		- CONSTANT			\longrightarrow
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,00
Condensers						
A. Shells and accessories	2,670,000	2,700,000	2,715,000	2,790,000	2,880,000	3,150,000
B. Dry vacuum pumps C. Tubes	2,000,000	2,004,000	2,010,000	2,025,000	2,064,000	2,250,000
D. Steam jet air equipment	28,875	28,875	28,875	26,250	26,250	49,87
E. Brection	423,000	426,000	428,000	485,000	447,000	480,000
F. Deaeration - hot well of	NONE -					142,00
cond. G. L-P heaters in exhaust stack	50,000	50,000	50,000	25,000	25,000	25,00
Circulating Water System						
A. Structures	١					
1. Crib house	[
a. Substructure				İ		
b. Superstructure				1		
c. Steel d. Miscellaneous	918,000	922,000	926,000	9\$4,000	952,000	999,00
2. Dredging	٠ م					
 Intake flume or forebay 				1		
4. Seal well						
5. Discharge flume	ļ					
 Outfall Crib house equipment (erected) 	ì			ı		
1. Traveling screens						
Screen wash pumps	218,000	221,000	223,000	226,000	234,000	254,00
3. Screen wash piping	(
4. Chlorination equipment]					
 Chlorine handling Circulating water piping 	1,237,000	1 266 000	1,250,000	1,250,000	1,286,000	1,352,00
D. Circulating water pumps	1,23/,000	1,244,000	1,150,000	1,100,000	2,200,000	2,032,00
1, Pumps	645,000	650,000	655,000	656,000	692,000	755,00
2. Motors	377,000	379,000	381,000	385,000	395,000	418,00
3. Erection	43,800	44,000	44,200	44,600	45,500	48,00
Feed Water Heaters		am	07/ 500	101 500	127 500	
A. L-P closed heaters B. H-P closed heaters	452,500	271,000	274,500	181,500	137,500	
C. Deaerating heater	476,000 369,000	448,000 357,000	216,000 347,400	185;000 389;600	267,400	189,00
D. Insulation		41	10 (00	F 200		
1. Closed heaters	27,700	21,500	12,600	5,300		
2. Deaerators E. Structural work	27,200	26,300	25,500	25,000	19,900	
1. For closed heaters	31,500	21,000	10,500	10,500		
2. For deaerators	80,000	76,500	74,000	72,000	59,900	
Boiler Feed Pumps				1		
A. Pumps and base plates	478,000	439,000	420,000	396,000	381,000	373,00
B. Fluid drive	333,000	333,000	333,000	241,000	241,000	241,00 526,00
C. Motors	657,000 46,900	627,000 43,600	587,000 42,100	555,000 40,000	532,000 39,200	38,20
D. Erection E. Foundation for pumps	11,200	10,400	10,000	9,400	9,200	8,90
		•	•) T		
Condensate Pumps A. Pumps	163,000	109,000	112,000	83,000	88,000	
B. Motors	108,700	59,200	60,100	38,400	40,300	
C. Erection	14,000	13,300	13,400	12,800	13,200	
Piping and Insulation _						
A. Extraction steam	603,000	536,400	441,000	381,600	243,000	143,70
B. Heater vents and drains	435,000	435,000	277,000	277,000	173,200	335,50
C. Feed water piping	433,000	433,000	2//,000	277,000	2,5,200	555,50
D. Condensate piping 1. From condensate pumps	1					
through L-P heaters.	196,000	166,000	166,000	165,500	165,500	
To deserator and B.F.	(
pump suction	54,500	54,500	30,000	30,000	30,000	30,00
3. Main steam						
Demineralizing Equipment	250,000	237,500	227,000	218,000	213,000	212,00
and Condensate Storage Tanks		B/2 224	202 222	200	202 200	520 00
Electrical	353,400	340.200	333,200	324,400	322,000	268,80
Turbine Room Building						
Total Items 1-10	38,923,275	38,439,275	37,868,375	37,502,850	37,167,050	37,433,97
Total Constant Cost	11,874,000	11,874,000.	11,874,000	11,874,000	11,874,000	11,874,00
Total Turbine Plant Cost	50,797,275	50,313,275	49,742,375	49,376,850	49,041,050	49,307,97
TACAL TATALHE LIGHT CORE						
Piping In Containment Vessel	724,000 51,521,275	724,000 51,037,275	747,000 50,489,375	747,000 50,123,850	744,000 49,785,050	746,00 50,053,97

SUMMARY OF COST DATA 1200 PSIA, 767 F THROTTLE STEAM (200 F SUPERHEAT) 1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
 Turbine Generator and Access A. Turbine generator unit 	23,300,000	23,300,000	23,300,000	23,300,000	23,300,000	23,300,000
B. Turbine generator erection	700 000	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter			CONSTANT	1,45,000	14E 000	
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000
. Condensers				-		
A. Shells and accessories	7 2505,000	2,535,000	2,550,000	2,580,000	2,700,000	2,940,000
B. Dry vacuum pumps	2,505,000			1		
C . Tubes	1,806,000	1,830,000	1,845,000	1,875,000	1,950,000 26,250	2,115,000 49,875
D. Steam jet air equipment	28,875	28,875	28,875	26,250 414,000	426,000	459,000
E. Erection	402,000	405,000	409,000	717,000		132,000
F. Deaeration - hot well of	NONE -			+		,
cond. G. L-P heaters in exhaust st	ack 50,000	50,000	50,000	25,000	25,000	25,000
	.ack,		•	1		
. Circulating Water System	-					
A. Structures 1. Crib house]					
a. Substructure	i					
b. Superstructure	1					
c. Steel						0/5 000
d. Miscellaneous	\$ 890,000	894,000	898,000	905,000	923,000	965,000
Dredging	(
Intake flume or foreba	ty					
4. Seal well	<u> </u>			1		
5. Discharge flume	J					
6. Outfall				\$.		
 B. Crib house equipment (ere 1. Traveling screens 	:::::::::::::::::::::::::::::::::::::::			ì		
2. Screen wash pumps	207,000	209,000	210,000	214,000	211,000	239,000
3. Screen wash piping	٠ ح			1		
4. Chlorination equipment	<u>.</u> Ì			!		
5. Chlorine handling				1 220 000	1 265 000	1,303,000
C. Circulating water piping	1,198,000	1,204,000	1,209,000	1,220,000	1,245,000	1,505,000
D. Circulating water pumps	606 000	612,000	617,000	628,000	652,000	709,000
1. Pumps	606,000 362,000	365,000	367,000	370,000	379,000	400,000
2. Motors 3. Erection	42,400	42,600	42,800	43,200	44,100	46,200
3. Erection	,	,				
. Feed Water Heaters	616 000	251,000	254,500	123,000	128,500	
A. L-P closed heaters	416,000 437,000	413,000	200,000	172,000		177,000
B. H-P closed heaters	349,500	339,000	265,000	260,000	256,400	
C. Descrating heater	0.7,000	,	•			
D. Insulation 1. Closed heaters	25,200	19,200	11,500	4,800		
2. Deserators	25,700	25,000	19,700	19,200	19,000	
E. Structural work				10 500	+	
1. For closed heaters	31,500	21,000	10,500	10,500		
For deserators	74,700	72,000	59,000	57,300	56,400	
. Boiler Feed Pumps			,			
A. Pumps and base plates	438,000	405,000	389,000	368,000	361,000	350,000 241,000
B. Fluid drive	333,000	241,000	241,000	241,000	241,000	486,000
C. Motors	589,000	566,000	532,000 39,500	505,000 37,800	487,000 37,200	36,300
D. Erection	43,500	40,800 9,600	9,300	8,800	8,600	8,400
E. Foundation for pumps	10,300	3,000	,,500	0,000	.,	-
. Condensate Pumps					23 222	
A. Pumps	148,000	100,000	101,000	77,000	81,000 37 500	
B. Motors	98,900	54,600	55,300	35,800 12,300	37,500 12,600	
C. Erection	13,200	12,700	12,700	12,300	12,000	
. Piping and Insulation				i		
A. Extraction steam	603,000	532,500	441,000	381,600	243,000	143,700
B. Heater vents and drains	f ·		-	!		335,500
C. Feed water piping	435,000	350,500	277,000	277,000	173,200	22,200
D. Condensate piping	7					
1. From condensate pumps	196,000	166,000	166,000	166,500	166,500	
through L-P heaters.	7 250,000					
To deaerator and B.F. pump suction				i .		
E. Main steam	103,000	103,000	92,200	85,200	85,200	85,200
		218 000	210,000	203,000	198,000	197,500
. Demineralizing Equipment	229,000	218,000	210,000	200,000	_,,,,,,,	,
		224 100	317 000	310 600	309,700	256,100
and Condensate Storage Tanks	335,100	324,100	317,900	310,600		
and Condensate Storage Tanks				1		
	.					
and Condensate Storage Tanks C. Electrical C. Turbine Room Building		36,784,475	36,275,775	35,001,850	35,828,150	36,044,77
and Condensate Storage Tanks Electrical Turbine Room Building Total Items 1-10	37,376,875	36,784,475	36,275,775		35,828,150 11,874,000	36,044,775 11,874,000
and Condensate Storage Tanks Electrical Turbine Room Building Total Items 1-10 Total Constant Cost	37,376,875 11,874,000	36,784,475 11,874,000	36,275,775 11,874,000	35,001,850 11,874,000 47,875,850		11,874,00
and Condensate Storage Tanks 2. Electrical 2. Turbine Room Building Total Items 1-10	37,376,875 11,874,000 49,250,875	36,784,475	36,275,775	11,874,000	11,874,000	

SUMMARY OF COST DATA 1200 PSIA, 867 F THROTTLE STEAM (300 F SUPERHEAT) 1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
. Turbine Generator and Accessories						
A. Turbine generator unit	23,400,000	23,400,000	23,400,000	23 400,000	23,400,000	23,400,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter		2/5 222	- CONSTANT	245 000	345,000	345,000
D. Turbine foundation	345,000	345,000	345,000	345,000	343,000	343,000
. Condensers -						
A. Shells and accessories	2,340,000	2,370,000	2,400,000	2 430,000	2,535,000	2,805,000
B. Dry vacuum pumps				1		-
C. Tubes	1,692,000	1,704,000	1,710,000	1,731,000	1,830,000	1,965,000 49,875
D. Steam jet air equipment	28,875	28,875	28,875 384,000	26,250 390,000	26,250 405,000	430,000
E. Erection	381,000 NONE	383,000	364,000	3903000		126,000
F. Deacration - hot well of cond.	10112			ĺ		•
G. L-P heaters in exhaust stack	50,000	50,000	50,000	25,000	25,000	25,000
				-		
. Circulating Water System A. Structures						
1. Crib house						
a. Substructure						
b. Superstructure				-		
c. Steel		24- 222	040.000	075 000	904 000	929,000
d. Miscellaneous	> 861,000	865,000	868,000	875,000	894,000	929,000
2. Dredging				j		
3. Intake flume or forebay						
4. Seal well 5. Discharge flume				4		
6. Outfall				<u> </u>		
B. Crib house equipment (erected)				Ī		
1. Traveling screens		104 000	107.000	200 000	209,000	224,000
 Screen wash pumps 	195,000	196,000	197,000	200,000	209,000	224,000
3. Screen wash piping						
4. Chlorination equipment						
5. Chlorine handling	1,158,000	1,163,000	1,167,000	1,178,000	1,205,000	1,254,000
C. Circulating water piping D. Circulating water pumps	-,,	-,,	g g	, ,	•	
1. Pumps	567,000	571,000	575,000	586,000	612,000	660,000
2. Motors	348,000	350,000	351,000	355,000	365,000	382,000
Erection	41,000	41,200	41,300	41,700	42,700	44,400
. Feed Water Heaters						
A. L-P closed heaters	386,500	235,000	238,000	115,000	120,500	
B. H-P closed heaters	408,000	386,000	187,500	162,000		168,000
C. Deacrating heater	267,000	260,000	254,000	249,800	247,000	
D. Insulation	00 100	10 700	10.700	4,500		
1. Closed heaters	23,100	18,700 19,600	10,700 18,800	18,400	18,200	
2. Deaerators	19,900	19,000	20,000	20, 420	20,404	
E. Structural work	31,500	21,000	10,500	10,500		
 For closed heaters For deaerators 	59,800	57,600	55,800	54,200	53,500	
	•	-		1		
. Boiler Feed Pumps	407,000	378,000	365,000	348,000	342,000	333,000
A. Pumps and base plates B. Fluid drive	241,000	241,000	241,000	241,000	192,000	192,000
C. Motors	534,000	516,000	487,000	465,000	449,000	451,000
D. Erection	40,900	38,500	37,500	36,000	35,500	34,800
E. Foundation for pumps	9,700	9,000	8,700	8,400	8,200	8,000
. Condensate Pumps				i		
A. Pumps	135,000	92,000	94,000	72,000	75,000	
B. Motors	9,900	50,600	51,200	33,500	35,100	
C. Erection	12,600	12,100	12,200	11,800	12,100	
. Piping and Insulation						
A. Extraction steam	601,800	515,700	441,000	334,500	228,900	143,700
B. Heater vents and drains	•	-	-		-	· ·
C. Feed water piping	350,500	350,500	277,000	277,000	173,200	335,500
D. Condensate piping						
l. From condensate pumps	106 000	166,000	166,000	154,500	150,000	
through L-P heaters.	196,000	100,000	200,000	254,500	,	
2. To deserator and B.F.						
pump suction B. Main steam	118,000	118,000	118,000	118,000	118,000	118,000
			195,000	190,000	186,000	186,000
. Demineralizing Equipment	212,000	203,000	277,000	2,0,000	,	,
and Condensate Storage Tanks			200 122	200 000	200 500	245 400
. Electrical	320,400	310,200	305,100	298,800	298,500	245,400
. Turbine Room Building						
Total Items 1-10	36,572,475	36,165,575	35,791,175	35,485,850	35,336,650	35,554,675
		11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
	11.8/4.000					
Total Constant Cost	11,874,000 48,446,475			47,359,850	47,210,650	47,428,675
Total Constant Cost Total Turbine Plant Cost	48,446,475	48,039,575	47,665,175	47,359,850	47,210,650 1,000,000	
Total Constant Cost						47,428,675 1,008,000 48,436,675

SUMMARY OF COST DATA
1200 PSIA, 967 F THROTTLE STEAM
(400 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arran	Rement	- 6	5	4	- 3	2	1
1. Turbine Generator				-		<u> </u>	
A. Turbine generat	or unit	23,560,000	23,560,000	23,560,000	23,560,000	23,560,000	23,560,00
B. Turbine generat	or erection	700,000	700,000	700,000	700,000	700,000	700,00
C. Reserve exciter			*	CONSTANT			
D. Turbine foundat	ion	345,000	345,000	345,000	345,000	345,000	345,00
. Condensers					_ `	-	-
A. Shells and acce	ssories 7	2 205 200	0.005.000	4 050 000	J		
B. Dry vacuum pump		2,205,000	2,235,000	2,250,000	2,280,000	2,380,000	2,550,00
C. Tubes		1,584,000	1,605,000	1,620,000	1,650,000	1,707,000	1,845,00
D. Steam jet air e	quipment	28,875	28,875	28,875	26,250	26,250	26,25
E. Erection		363,000	366,000	369,000	372,000	413,000	409,00
F. Descration - ho	t well of	NONE					115,00
cond,		50,000	50 000	50 000	25.000	95 000	25 00
G. L-P heaters in		50,000	50,000	50,000	25,000	25,000	25,00
. Circulating Water (System						
A. Structures 1. Crib house)			·		
a. Substructi		1					
b. Superstruc c. Steel	cure						
d. Miscellane	0118	835,000	840,000	844,000	850,000	864,000	898,000
2. Dredging	Oug	7	,	,	227,000	001,000	550,00
3. Intake flume	or forehey	ļ			1		
4. Seal well		İ					
Discharge flu	me	ł			.]		
6. Outfall		ļ					
B. Crib house equip	ment (erected)	1			ì		
 Traveling scr 		1					
2. Screen wash p		183,000	185,000	187,000	189,000	195,000	210,000
3. Screen wash p	iping	Į.			ľ		
 Chlorination Chlorine hand 	equipment				<u> </u>		
C. Circulating water	r odod-o	1,121,000	1,128,000	1,131,000	1,142,000	1,162,000	1,209,000
D. Circulating water	, behruft	-,,	.,,	-, ,	7, 1, 1, 1, 1, 1	1,102,000	-,,
1. Pumps	· paaps	531,000	538,000	543,000	551,000	570,000	617,000
2. Motors		335,000	337,000	338,000	342,000	349,000	366,000
Erection		39,600	39,800	40,000	40,400	41,100	42,80
Feed Water Heaters							
A. L-P closed heater	:a	355,000	219,000	232,000	109,000	113,000	
B. H-P closed heater	:8	384,500	364,000	177,000	154,000		160,000
C. Desersting heater	•	257,000	250,400	247,600	240,400	238,400	
D. Insulation							
1. Closed heaters		21,300	16,400	10,000	4,200	17 600	*****
2. Deserators		19,000	18,400	18,000	17,700	17,600	
E. Structural work		31,500	21,000	10,500	10,500		
 For closed hea For deaerators 		56,400	54,500	53,000	51,800	51,200	
			,			,	
Boiler Feed Pumps		382,000	356,000	349,000	130 000	326,000	318,000
A. Pumps and base pl B. Fluid drive	ates	241,000	241,000	192,000	330,000 192,000	192,000	192,000
C. Motors		492,000	476,000	451,000	432,000	421,000	422,00
D. Erection		38,900	36,800	35,900	34,600	34,200	33,50
E. Foundation for pu	mne	9,100	8,500	8,300	8,000	7,900	7,70
		,,	*,5.5	0,544	, ,,,,,	.,	.,,,
Condensate Pumps		125,000	86,000	87,000	68,000	70,000	
A. Pumps B. Motors		84,200	47,300	47,900	31,500	32,900	
C. Erection		12,000	11,600	11,700	11,300	11,600	
			,	,	,	,	
Piping and Insulation	, ~						
A. Extraction steam B. Heater vents and o	,,,,, }	595,200	514,200	441,000	334,500	228,900	143,700
C. Feed water piping	=108	350,500	350,500	227,000	277,000	173,200	335,500
D. Condensate piping	_	220,200	3,70,300	447,000	4,7,000	173,200	
1. From condensate	puznos I				!		
through L-P hea	iters.	183,500	154,000	150,000	150,000	150,000	
2. To deserator an	d B.F.	•	••	•	1		
pump auction	ل.				1		
B. Main steam		138,000	138,000	138,000	138,000	138,000	138,000
Demineralizing Equipm	ent	198,000	190,000	184,000	179,000	176,000	177,000
and Condensate Stores	e Tanks	•	•	•	1		•
Electrical ·		307,100	298,800	294,800	289,000	288,900	235,700
						•	
Turbine Room Building	;					**	
Total Items 1-10		36,161,675	35,810,075	35,421,575	35, 135, 150	35,008,150	35,081,150
Total Constant Cost		11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant (ost	48,035,675	47,684,075	47,295,575	47,009,150	46,882,150	46,955,150
racer respectfe traff (
Piping In Containment	Vessel	1,066,000	1,066,000	1,058,000	1,058,000	1,049,000 47,931,150	1,061,000 48,016,150

SUMMARY OF COST DATA
1000 PSIA, 545 F THROTTLE STEAM
(SATURATED STEAM)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	- 6	3	4	3	2	1
. Turbine Generator and Accessori	es					
A. Turbine generator unit	25,000,000	25,000,000	25,000,000	25,000 000 700 000	25,000,000	25,000,000
B. Turbine generator erection	700,000	700,000	700,000 CONSTANT	7001000	700,000	700,000
C. Reserve exciter D. Turbine foundation	345,000	345,000	345,000	345 000	345,000	345,000
. Condensers	٦.					
A. Shells and accessories	2,985,000	3,000,000	3,030,000	3,090,000	3,210,000	3,480,000
B. Dry vacuum pumps C. Tubes	2,145,000	2,160,000	2,175,000	2,205,000	2,310,000	2,505,000
D. Steam jet air equipment	28,875	28,875	28,875	26, 250	26,250	47,250
E. Brection	462,000	465,000	470,000	477 000	495,000	528,000
F. Descration - hot well of	none					157,000
cond. G. L-P heaters in exhaust stack	50,000	50,000	50,000	25,000	25,000	25,000
. Circulating Water System						
A. Structures						
1. Crib house a. Substructure						
b. Superstructure						
c. Steel						
d. Miscellaneous	972,000	975,000	982,000	993,000	1,013,000	1,060,000
2. Dredging				1		
Intake flume or forebay	ļ			1		
4. Seal well]			1		
5. Discharge flume				i		
6. Outfall B. Crib house equipment (erecte	<u></u>			į		
1. Traveling screens	" "					
2. Screen wash pumps	242,000	244,000	246,000	251,000	260,000	280,000
3. Screen wash piping	7					
 Chlorination equipment 	İ					
5. Chlorine handling		1 210 000	1 220 000	1,343,000	1 372 000	1,437,000
C. Circulating water piping	1,314,000	1,319,000	1,328,000	1,343,000	1,372,000	114211000
D. Circulating water pumps	719,000	722,000	732,000	746,000	775,000	839,000
1. Pumps 2. Motors	404,000	406,000	409,000	415,000	425,000	449,000
3. Erection	46,500	46,700	47,000	47,100	47,600	51,000
. Feed Water Heaters A. L-P closed heaters	471,000	298,000	303,500	147,000	154,000	
B. H-P closed heaters	504,500	452,500	204,000	176,500		204,500
C. Deserating heater	395,400	382,500	369,600	361,800	355,800	
D. Insulation]		
1. Closed heaters	30,000	22,400	12,800	5,100	26,200	
2. Deaerators	29,400	28,200	27,200	26,600	20,200	
E. Structural Work	31, 500	21,000	10,500	10,500		
1. For closed heaters	31,500 87,700	83,600	80,100	78,000	76,500	
2. For deaerators				1		
. Boiler Feed Pumps	328,000	303,000	288,000	274,000	267,000	258,000
A. Pumps and base plates B. Fluid drive	241,000	241,000	241,000	241,000	192,000	192,000
C. Motors	558,000	534,000	491,000	472,000	452,000	454,000
D. Brection	45,900	42,500	40,500	38,600	37,700	36,600
E. Foundation for pumps	12,400	11,500	10,900	10,300	10,100	9,700
. Condensate Pumps				1		
A. Pumps	187,00	125,000	126,000	96,000	101,000	
B. Motors	107,400	63,200	62,600	42,900	45,300 14,300	
C. Erection	15,300	14,400	14,500	13,800	14,500	-
Piping and Insulation				200	242 000	120 600
A. Extraction steam	578,100	511,200	416,100	381,600	243,000	129,600
B. Heater vents and drains	3 25 500	256 500	225,500	225,500	143,100	265,000
C. Feed water piping	356,500	356,500	22,300	220,500	140,100	
D. Condensate piping -	7			1		
 From condensate pumps through L-P heaters. 	290,200	203,500	202,700	185,800	185,800	
2. To deserator and B.F.	7	•		i		
pump suction				.L		
E. Main steam	- 58,700	56,500	51,700	47,500		47,500
Demineralizing Equipment	281,000	265,000	251,000	243,000	236,000	234,000
and Condensate Storage Tanks	-	-	•	 		
. Electrical	340,600	329,500	322,100	316,000	314,700	261,400
		******	*******			
. Turbine Room Building				!		
Total Items 1-10	40,362,975	39,806,575	39,294,175	39,056,850		38,995,55
		11 974 000	11,874,000	11,874,000	11,874,000	11,874,00
Total Constant Cost	11,874,000	11,874,000				
	52,236,975	51,680,575	51,168,175	50,930,850	50,779,850	50,869,55
Total Constant Cost					50,779,850 661,000	50,869,550 671,000 51,540,550

SUMMARY OF COST DATA
1000 PSIA, 645 F THROTTLE STEAM
(100 F SUPERHEAT)
1000 MMe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
. Turbine Generator and Accesso	ries					
A. Turbine generator unit	24,100,000	24,100,000	24,100,000	44,100,000	24,100,000	24,100,00
B. Turbine generator erection C. Reserve exciter	700,000	700,000	700,000	700,000	700,000	700,00
D. Turbine foundation	345,000	345,000	CONSTANT	345 000	2/2 000	
Condensers	343,000	343,000	345,000	345,000	345,000	345,00
A. Shells and accessories	٦ .					
B. Dry vacuum pumps	2,790,000	2,795,000	2,820,000	2,865,000	2,990,000	3,240,00
C. Tubes	2,010,000	2,025,000	2,040,000	2,070,000	2,146,000	2,340,00
D. Steam jet air equipment	28,875	28,875	28,875	26,250	26,250	47.2
E. Brection F. Deseration - hot well of	438,000	440,000	443,000	450,000	462,000	498,00
cond.	none —			1		146,00
G. L-P heaters in exhaust stac	k 50,000	50,000	50,000	25,000	25,000	25,00
Circulating Water System			•		,	
A. Structures						
1. Crib house	İ			+		
a. Substructure						
 b. Superstructure c. Steel 	1					
d. Miscellaneous	939,000	942,000	946,000	954,000	973,000	1 020 00
2. Dredging	[, ,,,,,,,	540,000	334,000	373,000	1,020,00
 Intake flume or forebay 				}		
4. Seal well	-					
 Discharge flume Outfall 	J]		
B. Crib house equipment (erect	• <u>5</u>			N. E.		
1. Traveling screens	•••/			Ē		
Screen wash pumps	228,000	229,000	231,000	234,000	242,000	263,00
Screen wash piping	(
4. Chlorination equipment						
5. Chlorine handling C. Circulating water piping	1,267,000	1,271,000	1,273,000	1,288,000	1,315,000	1,381,00
D. Circulating water pumps	-,,	-,,	2,2,5,000	1,200,000	2,323,000	1,301,00
1. Pumps	673,000	678,000	683,000	694,000	720,000	784,00
2. Motors	388,000	389,000	391,000	395,000	405,000	428,00
3. Brection	44,800	45,100	45,200	45,700	46,600	49,00
Feed Water Heaters						
A. L-P closed heaters	438,000	286,500	272,500	135,000	141,500	
B. H-P closed heaters	450,000	407,000	186,000	162,000		188,00
C. Deserating heater D. Insulation	369,000	357,600	348,000	342,600	338,400	
1. Closed heaters	26,700	20,400	11,600	4,600		*
Deserators	27,200	26,300	25,600	25,200	24,900	
E. Structural Work	03 500					
1. For Closed Heaters 2. For Deaerators	31,500 79,900	21,000	10,500	10,500	71 700	
	75,500	76,800	74,100	72,500	71,700	
Boiler Feed Pumps	204 000	275 000	001.000	250.000		
A. Pumps and base plates B. Fluid drive	294,000 241,000	275,000 241,000	264,000 241,000	253,000 241,000	248,000	240,00
. Motors	577,000	551,000	516,000	496,000	241,000 477,000	241,00 476,00
). Erection	41,300	38,700	37,300	35,700	35,100	34,10
. Foundation for pumps	11,000	10,400	10,000	9,500	9,300	9,00
ondensate Pumps				- }		
. Pumps	166,000	117,000	113,000	86,000	91,000	
. Motors	95,600	59,500	57,800	39,500	41,400	
. Erection	14,200	13,800	13,600	13,000	13,400	
iping and Insulation	~			i		
. Extraction steam	578,100	511,200	416,100	381,600	243,000	129,60
- Heater vents and drains - Feed water piping	364,500	364,500	277,000	236,800	173,200	283,50
. Condensate piping		201,300	2,,,000	230,000	173,200	200,00
1. From condensate pumps	1			j		
through L-P heaters.	196,000	166,000	166,000	166,500	166,500	
To deserator and B.F.	l			1		
pump suction . Main steam		37 500	24 500	95 500		
	40,200	37,500	37,500	37,500	37,500	37,50
emineralizing Equipment	250,000	237,500	228,000	222,000	216,000	214,00
nd Condensate Storage Tanks		***				
lectrical	338,300	328,900	321,000	315,200	314,300	261,10
urbine Room Building						
otal Items 1-10	38,631,275	38,185,575	37,722,675	37,477,650	37,379,050	37,480,05
otal Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,00
otal Turbine Plant Cost	50,505,275	50,059,575	49,596,675	49,351,650	49,253,050	49,354,05
iping In Containment Vessel	720,000	689,000	779,000	779,000	776,000	642,00
rand Total	51,225,275	50,748,575	50,375,675	50,130,650	50,029,050	49,996,050

SUMMARY OF COST DATA 1000 PSIA, 745 F THROTILE STEAM (200 F SUPERHEAT) 1000 MWe INDIRECT CYCLE TURBINE PLANT

_	Reater Arrangement	6	5	4	,	2	1
1	Turbine Generator and Accessorie						
_	A. Turbine generator unit	23,300,000	23,300,000	23,300,000	23,300,000	23,300,000	23,300,000
	B. Turbine generator erection	700,000	700,000	700,000	70 0,00 0	700,000	700,000
	C. Reserve exciter	365.000	24E 000	CONSTANT	244 000	945 000	345.000
	D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000
2.	Condensers						
	A. Shells and accessories	2,595,000	2,610,000	2,640,000	2,700,000	2,790,000	3,030,000
	B. Dry vacuum pumps C. Tubes	1,875,000	1,884,000	1,905,000	1,935,000	2,010,000	2,175,000
	D. Steam jet air equipment	28,875	28,875	28,875	26,250	26,250	47,250
	E. Erection	414,000	415,000	417,000	426,000	438,000	471,000
	F. Deseration - hot well of	NONE					136,000
	cond. G. L-P heaters in exhaust stack	50,000	50,000	50,000	2\$,000	25,000	25,000
		,	*-,	,		,	,
3.	Circulating Water System A. Structures	`					
	1. Crib house						
	a. Substructure						
	b. Superstructure						
	c. Steel	905,000	909,000	912,000	922,000	939,000	981,000
	d. Miscellaneous 2. Dredging	> ,,,,,,,,	,0,,000	,,,,,,,,,	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
	3. Intake flume or forebay						
	4. Seal well	1					
	Discharge flume				ı		
	6. Outfall	ζ			ì		
	 Crib house equipment (erected) Traveling screens 	'					
	2. Screen wash pumps	213,000	215,000	217,000	211,000	228,000	246,000
	3. Screen wash piping	> 2,5,000	215,000	227,000		,	_,,,,,,,,,
	 Chlorination equipment 	1					
	5. Chlorine handling	J					
	C. Circulating water piping D. Circulating water pumps	1,220,000	1,225,000	1,230,000	1,244,000	1,267,000	1,326,000
	1. Pumps	627,000	632,000	637,000	651,000	673,000	730,000
	2. Motors	371,000	372,000	374,000	379,000	388,000	408,000
	3. Erection	43,200	43,400	43,600	44,100	44,800	47,000
4.	Feed Water Heaters						
	A. L-P closed heaters	402,000	255,500	258,500	125,000	132,000	
	B. H-P closed heaters	414,000	376,000	172,500	152,000	*******	176,500
	C. Deaerating heater D. Insulation	349,800	340,500	266,000	262,000	259,600	
	1. Closed heaters	24,300	18,200	10,700	4,200		
	2. Deserators	25,800	25,000	19,800	19,400	19,200	
	g. Structural Work						
	1. For Closed Heaters 2. For Deserators	31,500	21,000	10,500	10,500		
	2. For Deaerators	75,000	72,000	59,200	58,100	57,200	
	Boiler Feed Pumps		855 000	0/7 000	000	224 000	999 000
	A. Pumps and base plates B. Fluid drive	272,000 241,000	255,000 241,000	247,000 241,000	237,000 192,000	234,000 192,000	228,000 192,000
	C. Motors	518,000	498,000	469,000	452,000	438,000	439,000
	D. Erection	38,300	36,100	35,000	38,700	33,200	32,400
	E. Foundation for pumps	10,300	9,600	9,300	8,900	8,800	8,600
	Condensate Pumps				i		
	A. Pumps	150,000	102,000	103,000	79,000	83,000	
	B. Motors	87,000	52,600	53,200	36,800	38,500	
	C. Erection	13,300	12,800	12,900	12,500	12,800	
	Piping and Insulation				ŀ		
	A. Extraction steam	} ,,,,	/OF /OO	616 600	201 200	242 000	129,600
	B. Heater vents and drains C. Feed water piping	f 577,800 364,500	485,400 364,500	414,600 277,000	381,300 235,800	243,000 173,200	283,500
	D. Condensate piping	`	504,500	2,,,000	250,500	1,5,000	,
	1. From condensate pumps	1					
	through L-P heaters.	196,000	166,000	166,000	166,500	166,500	
	To deserator and B.F.	Ì					
	pump suction E. Main steam	40,200	37,500	37,500	37,500	37,500	37,500
					205,000	202,000	201,000
	Demineralizing Equipment	230,000	218,000	211,000	200,000	202,000	202,000
	and Condensate Storage Tanks	321 200	312 200	307,400	302,400	302,200	249,100
	Electrical	321,200	312,200				
•	Turbine Room Building				25 407 450	25 004 750	25 044 440
	Total Items 1-10	37,069,075	36,628,175	36,180,575	35,921,950	35,806,750	35,944,450
	Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
	Total Turbine Plant Cost	48,943,075	48,502,175	48,054,575	47,795,950	47,680,750	47,818,450
	Piping In Containment Vessel Grand Total	788,000 49,731,075	744,000 49,246,175	836,000 48,890,575	836,000 48,631,950	832,000 48,512,750	700,000 48,518,450

SUMMARY OF COST DATA
1000 PSIA, 845 F THROTTLE STEAM
(300 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6.	5	4	3	2	1
. Turbine Generator and Accesso	ries					
A. Turbine generator unit	23,400,000	23,400,000	23,400,000	23,400,000	23,400,000	23,400,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter		217.000	CONSTANT	2/5 000	0/5 000	215.00
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000
. Condensers	_					
A. Shells and accessories	2,410,000	2,430,000	2,460,000	2,520,000	2,610,000	2,795,000
B. Dry vacuum pumps	1			1 .		
C. Tubes	1,755,000	1,770,000	1,785,000	1,815,000	1,875,000	1,922,00
D. Steam jet air equipment	28,875 396,000	28,875 399,000	28,875 400,000	26,250 405,000	26,250 414,000	47,25 440,00
E. Erection	NONE -	355,000	400,000	705,000		126,00
F. Deseration - hot well of cond.						,
G. L-P heaters in exhaust sta	ck 50,000	50,000	50,000	25,000	25,000	25,00
	- Jo,000	30,000	50,000	25,000	25,000	25,00
. Circulating Water System						
A. Structures 1. Crib house				İ		
a. Substructure				ļ		
b. Superstructure	}					
c. Steel	}					
d. Miscellaneous	876,000	879,000	884,000	892,000	907,000	942,00
Dredging	, ·				,	
Incake flume or forebay				ļ		
4. Seal well	1			į		
5. Discharge flume	ĺ			1		
6. Outfall	. =					
 B. Crib house equipment (erect 1. Traveling screens 	(ed)			Ė		
2. Screen wash pumps	201,000	202,000	204,000	208,000	214,000	229,00
3. Screen wash piping	>,		*		•	-
4. Chlorination equipment	\ \					
5. Chlorine handling						
C. Circulating water piping	1,179,000	1,184,000	1,190,000	1,201,000	1,222,000	1,272,00
D. Circulating water pumps		*** ***	FAO. 600	caa aaa	£40,000	677.00
1. Pumps	587,000	592,000	598,000 359,000	608,000 363,000	629,000 371,000	677,00 389.00
2. Motors	351,000 41,800	357,000 41,900	42,100	42,500	43,300	45,00
3. Erection	41,000	42,500	42,100	42,500	45,500	45,00
Feed Water Heaters		000 500	010.000	110 000	100.000	
A. L-P closed heaters	374,000	239,500	242,000	118,000 143,500	123,000	167,50
B. H-P closed heaters	386,500 268,000	351,500 261,000	162,500 256,000	252,000	250,000	107,50
C. Deserating heater D. Insulation	200,000	201,000	250,000	232,000	230,000	
1. Closed heaters	22,500	16,800	9,900	3,900		
2. Deserators	19,900	19,400	18,900	18,600	18,400	
E. Structural Work	•					
 For Closed Heaters 	31,500	21,000	10,500	10,500		
For Degerators	60,000	57,700	56,000	55,000	54,400	
Boiler Feed Pumps				ļ		
A. Pumps and base plates	255,000	240,000	233,000	226,000	223,000	217,00
B. Fluid drive	241,000	192,000	192,000	192,000	192,000	192,00
C. Motors	474,000	456,000	432,000	417,000	406,000	410,00
D. Brection	36,100	34,100	33,200	32,000	31,700	31,00
E. Foundation for pumps	9,600	9,000	8,800	8,500	8,300	8,10
Condensate Pumps						
A. Pumps	137,000	95,000	96,000	74,000	77,000	
B. Motors	80,200	48,900	49,500	34,400	35,900	
C. Erection	12,700	12,200	12,300	12,000	12,300	
Piping and Insulation			105 000	247 500	261 500	120 60
A. Extraction steam	─ 562,200	483,900	406,200	367,500	241,500	129,60
B. Heater vents and drains	_}					
C. Feed water piping	350,500	350,500	277,000	236,800	173,200	283,50
D. Condensate piping	_					
 Prom condensate pumps 	100 000	144 000	166 000	154 500	164 500	
through L-P heaters.	196,000	166,000	166,000	154,500	154,500	******
2. To descrator and B.F.	1			1		
pump suction		110,700	103,000	103,000	103,000	103,00
E. Main steam	2203100	,,				
Demineralizing Equipment	213,000	204,000	197,000	193,000	190,000	190,00
and Condensate Storage Tanks	,	,	,			
Electrical	307,700	299,900	296,000	291,600	291,500	238,40
Turbine Room Building						
	36,468,775	36,047,875	35,703,775	35, 494, 550	35,367,250	35,324,35
Total Items 1-10					11,874,000	11,874,00
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000		
Total Turbine Plant Cost	48,342,775	47,921,875	47,577,775	47,368,550	47,241,250	47,198,35
Piping In Containment Vessel	1,075,000	976,000 48,897,875	1,058,000 48,635,775	1,057,000 48,425,550	1,050,000 48,291,250	922,00 48,120,35
Grand Total	49,417,775					

SUMMARY OF COST DATA
1000 PSTA, 945 F THROTTLE STEAM
(400 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

	1000 MW	e INDIRECT CYC	LE TURBINE PLAN	T		
Heater Arrangement	.6 - '	5	4	3	2	1
1. Turbine Generator and Accessorie	6				** *** ***	22 550 000
A. Turbine generator unit	23,560,000	23,560,000	23,560,000	23,550,000	23,560,000 700,000	23,560,000 700,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	015 000	2/5 000	CONSTANT	345,000	345,000	345,000
D. Turbine foundation	345,000	345,000	345,000	343,000	343,000	343,000
2. Condensers				•		
A. Shells and accessories	2,260,000	2,280,000	2,310,000	2,370,000	2,410,000	2,610,000
B. Dry vacuum pumps						1,875,000
C. Tubes	1,650,000	1,655,000	1,665,000	1,695,000 26,250	1,755,000 26,250	26,250
D. Steam jet air equipment	28,875 372,000	28,875 375,000	28,875 378,000	384,000	396,000	414,000
E. Erection	NONE	2,2,000	5,0,000			117,000
F. Deseration - hot well of cond.						
G. L-P heaters in exhaust stack	50,000	50,000	50,000	25,000	25,000	25,000
	•					
3. Circulating Water System				İ		
A. Structures 1. Crib house)					
a. Substructure						
b. Superstructure						
c. Steel				1		
d. Miscellaneous	849,000	851,000	855,000	863,000	876,000	908,000
2. Dredging	(•		
Intake flume or forebay	ì			!		
4. Seal well				1		
Discharge flume	i e			į.		
6. Outfall				1		
B. Grib house equipment (erected)	1					
1. Traveling screens	189,000	190,000	192,000	195,000	201,000	214,000
Screen wash pumps	> 105,000	150,000	2,2,000	7,3,000	,	
3. Screen wash piping	k			i		
4. Chlorination equipment 5. Chlorine handling						
C. Circulating water piping	1,141,000	1,144,000	1,150,000	1,161,000	1,179,000	1,224,000
D. Circulating water pumps	•					
1. Pumps	550,000	553,000	558,000	\$70,000	587,000	630,000
2. Motors	342,000	343,000	345,000	349,000	351,000	372,000
3. Erection	40,400	40,500	40,700	41,100	41,700	43,300
4. Feed Water Heaters						
A. L-P closed heaters	346,500	224,500	227,000	112,000	116,000	
B. H-P closed heaters	363,000	331,500	154,000	137,000		159,500
C. Deserating heater	258,000	251,000	246,000	243,000	241,200	
D. Insulation						
 Closed heaters 	20,700	15,700	9,300	3,700		
2. Deserators	19,000	18,500	18,100	17,900	17,800	
E. Structural work		01 000	10 500	10,500		
1. For closed heaters	31,500 56,800	21,000 54,800	10,500 53,200	52,500	51,900	
2. For deserators	30,000	34,000	55,200	32,5	,	
5. Boiler Feed Pumps	0/1 000	220 000	222 000	215,000	213,000	208,000
A. Pumps and base plates	241,000	228,000 192,000	222,000 192,000	192,000	192,000	192,000
B. Fluid drive	192,000 436,000	422,000	401,000	389,000	379,000	383,000
C. Motors	34,200	32,400	31,600	30,600	30,400	29,800
D. Erection B. Foundation for pumps	9,100	8,600	8,300	8,100	8,000	7,800
• •	,,		•			
6. Condensate Pumps	127,000	87,000	88,000	69,000	72,000	
A. Pumps	74,400	45,600	46,100	32,300	33,700	
B. Motors C. Erection	12,100	11,700	11,800	11,500	11,800	
		•	•	1		
7. Piping and Insulation -	١					*** /
A. Extraction steam	> 562,200	483,900	406,200	367,500	241,500	129,600
B. Heater vents and drains	350,500	350,500	277,000	236,800	173,200	283,500
C. Feed water piping D. Condensate piping	7.20,200	,		1	•	•
1. From condensate pumps	ļ					
through L-P heaters.	183,500	154,000	154,000	150,000	150,000	
2. To deserator and B.F.	1					
pump suction	J					103 000
E. Main steam	133,500	133,500	133,500	133,500	133,500	127,000
8. Demineralizing Equipment	199,000	192,000	185,000	183,000	180,000	181,000
and Condensate Storage Tanks					-	
9. Electrical	296,300	289,500	285,800	282,600	281,900	229,200
				1	,	
lO. Turbine Room Building		05 669 075	 16 227 B75	35 167 850		34,993,950
Total Items 1-10	36,023,575	35,663,075	35,337,975	35,161,850	34,979,850	
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	47,897,575	47,537,075	47,211,975	47,035,850	46,853,850	46,867,950
ll. Piping In Containment Vessel	1,171,000	1,074,000	1,158,000	1,152,000	1,142,000	1,033,000
Grand Total	49,068,575	48,611,075	48,369,975	48,187,850	47,995,850	47,900,950

SUMMARY OF COST DATA
800 PSIA, 518 F THROTTLE STEAM
(SATURATED STEAM)
1000 MMe INDIRECT CYCLE TURBINE PLANT

Tearer Wil	angement	6	. 5		- , -	2	
			· · · · · · · · · · · · · · · · · · ·		3	<u> </u>	1
 Turbine Generate A. Turbine generate 	r and Accessories	24,000,000	24,000,000	24,000,000	24 000 000	24 000 000	04 000 000
B. Turbine gener		700,000	700,000	700,000	24,000,000	24,000,000	24,000,000
C. Reserve excit	er	(,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	700,000	- CONSTANT	700,000	700,000	700,000
D. Turbine found	ation	345,000	345,000	345,000	345,000	345,000	345,000
. Condensers		-		,	7,,	240,000	345,000
A. Shells and ac	cessories 🧻						
B. Dry vacuum pu	apa /	3,120,000	3,165,000	3,210,000	3,300,000	3,420,000	3,720,000
C. Tubes	_	2,244,000	2,274,000	2,310,000	2,370,000	2,460,000	2,670,000
D. Steam jet air	equipment	28,875	26,250	26,250	26,250	26,250	42,000
E. Erection		480,000	486,000	495,000	503,000	520,000	560,000
F. Deseration - :	ot well of	NONE					167,000
cond. G. L-P heaters is	awhenet seest	50,000	50,000	E0 000	he 000	05.000	
		20,000	30,000	50,000	25,000	25,000	25,000
 Circulating Water A. Structures 	System						
1. Crib house					-		
a. Substruc	ture				1		
b. Superet:							
c. Steel	i				1		
d. Miscella	neous (997,000	1,005,000	1,013,000	1,027,000	1,050,000	1,101,000
2. Dredging	.				1		
3. Intake flum 4. Seal well	a or forebay				1		
5. Discharge f	luma				!		
6. Outfall	. Outle				1		
B. Crib house equ	pment (erected)				1		
1. Traveling s	reens				i		
Screen wash	pumps	253,000	256,000	260,000	256,000	276,000	298,000
3. Screen wash		•			7		
4. Chlorinatio	equipment				i		
5. Chlorine has	dling	1,349,000	1 261 000	1 270 000	1 201 000	1 /60 000	
C. Circulating was D. Circulating was	er piping	1,349,000	1,361,000	1,372,000	1,391,000	1,423,000	1,496,000
1. Pumps	er bombs	753,000	764,000	775,000	794,000	825,000	895,000
2. Motors		417,000	421,000	425,000	492,000	440,000	470,000
Erection		47,800	48,300	48,600	49,300	50,500	53,100
Feed Water Heaters						-	-
A. L-P closed heat		429,000	284,000	290,500	134,000	138,000	
B. R-P closed heat		446,000	406,500	193,000	120,500		174,500
C. Deserating heat	er	393,000	381,000	372,000	364,800	360,000	
D. Insulation							
1. Closed heate	r•	28,000	21,700	13,100	3,400		
2. Deserators E. Structural work		29,100	28,100	27,400	26,800	26,500	
1. For closed in		31,500	21,000	10,500	20,500		
2. For deaerato	24L3EB F4	87,200	83,400	80,800	78,800	77,600	
		,	,	00,000	,0,000	,,,,,,,,	
Boiler Feed Pumps		279,000	259 000	260.000	200 000	224 000	201 001
A. Pumps and base B. Fluid drive	>reres	192,000	258,000 192,000	249,000 192,000	238,000 192,000	234,000 192,000	226,000 192,000
C. Motors		462,000	450,000	417,000	399,000	384,000	392,000
D. Erection		40,600	37,900	36,600	\$5,000	34,400	33,400
E. Foundation for	oumpa	12,200	11,300	10,900	10,500	10,200	9,900
Condensate Pumps			•	•	1 *	-	•
A. Pumps		164,000	106,000	107,000	100,000	106,000	
B. Motors		94,700	58,500	59,500	44,700	47,000	
C. Erection		15,400	14,600	14,700	14, 100	14,600	
Piping and Insulat:	OB.				F 7		
A. Extraction steam		£00 000	EEC 200	164 400			
B. Heater vents and	drains	639,300	559,500	461,100	38 3,400	324,800	147,900
C. Feed water pipio	g	315,500	315,500	194,400	194,400	133,100	236,200
	<u>ه</u> ٦						
D. Condensate pipit	te pumps		***		.1		
 From condensa 	paters :	222,500	203,500	203,500	185,800	185,800	
 From condense through L-P h 	,				i		
 From condensa through L-P b To deserator 	and B.F.				54,200	53,700	52,700
through L-P h 2. To deserator pump suction	and B.F.	50 000	57 500				
From condense through L-P to deserator pump suction Main steam	and B.F.	59,000	57,500	56,200	1		
From condensathrough L-P To deserator pump suction E. Main steam Demineralizing Equi	and B.F	59,000 278,000	57,500 265,000	56,200 254,000	246,000	242,000	
From condensa through L-P h To deaerator pump suction Main steam Demineralizing Equi and Condensate Stor	and B.F	278,000	265,000	254,000	246,000	242,000	239,000
1. From condensathrough L-P b 2. To deaerator pump suction E. Main steam Demineralizing Equiand Condensate Stor Electrical	end B.F. pment* age Tanks				1		239,000
1. From condensathrough L-P b 2. To deaerator pump suction E. Main steam Demineralizing Equiand Condensate Stor Electrical	end B.F. pment* age Tanks	278,000	265,000	254,000	246,000	242,000	239,000 254,600
From condensa through L-P h To deaerator pump suction Main steam Demineralizing Equi and Condensate Stor	end B.F pment ⁴ age Tanke	278,000 322,300	265,000	254,000 310,200	246,000 306,100	242,000 306,200	239,000 254,600
1. From condensathrough L-P to deserator pump suction E. Main steam Demineralizing Equiand Condensate Stor Electrical Turbine Room Buildi Total Items 1-10	pment ⁴ age Tanke	278,000 322,300 39,324,975	265,000 314,800 	254,000 310,200 38,583,250	246,000 306,100 38,370,550	242,000 306,200 38,430,650	239,000 254,600 38,500,300
1. From condensathrough L-P to descrator pump suction E. Main steam Demineralizing Equiand Condensate Stor Electrical Turbine Room Buildi Total Items 1-10 Total Constant Cost	end B.F pment* age Tanks	278,000 322,300 39,324,975 11,874,000	265,000 314,800 30,971,350 11,874,000	254,000 310,200 38,583,250 11,874,000	246,000 306,100 38,370,550 11,874,000	242,000 306,200 38,430,650 11,874,000	239,000 254,600 38,500,300 11,874,000
1. From condensathrough L-P to deserator pump suction E. Main steam Demineralizing Equiand Condensate Stor Electrical Turbine Room Buildi Total Items 1-10	pment ⁴ age Tanks ng Cost	278,000 322,300 39,324,975	265,000 314,800 	254,000 310,200 38,583,250	246,000 306,100 38,370,550	242,000 306,200 38,430,650	239,000 254,600 38,500,300

SUMMARY OF COST DATA
800 PSIA, 518 F THROTTLE STEAM
(100 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
. Turbine Generator and Accesso	ries					
A. Turbine generator unit	23,370,000	23,370,000	23,370,000	23,370,000	23,370,000	23,370,00
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000	700,00
C. Reserve exciter D. Turbine foundation	345,000	345,000	CONSTANT - 345,000	345,000	345,000	345,00
. Condensers	•,	•,	,		,	•
A. Shells and accessories	2,940,000	2,955,000	2,985,000	3,030,000	3,150,000	3,435,00
B. Dry vacuum pumps	1			. 1		
C. Tubes	2,115,000	2,124,000	2,145,000	2,175 000	2,265,000	2,460,00
D. Steam jet air equipment	28,875	26,250	26,250	26 250 470 000	26,250 486,000	42,00 520,00
B. Erection	456,000 NONE	459,000	462,000	470,000	400,000	154,00
F. Deaeration - hot well of cond.	HOME			i	•	254,00
G. L-P heaters in exhaust sta	ck 50,000	50,000	50,000	25,000	25,000	25,00
Circulating Water System				-		
A. Structures	\neg			-		
 Crib house 						
a. Substructure						
b. Superstructure						
c. Steel	964,000	967,000	971,000	981,000	1,001,000	1,052,0
d. Miscellaneous 2. Dredging	> ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	,0,,000	,, -, ,	302,000	-,,	-,
3. Intake flume or forebay						
4. Seal well	ļ.					
5. Discharge flume				İ		
6. Outfall	}					
B. Crib house equipment (erec	ted)			1		
 Traveling screens 				į.		
Screen wash pumps	239,000	240,000	242,000	246,000	255,000	277,0
Screen wash piping	ſ					
4. Chlorination equipment	ì					
5. Chlorine handling	1 202 000	1 204 000	1 212 000	1 227, 000	1,355,000	1,426,0
C. Circulating water piping	1,302,000	1,306,000	1,313,000	1,327,000	1,333,000	1,420,0
D. Circulating water pumps 1. Pumps	708,000	711,000	717,000	731,000	759,000	828,0
2. Motors	400,000	401,000	403,000	409,000	419,000	445,0
3. Erection	46,200	46,300	46,500	47,000	48,000	50,6
	,			ſ		
Feed Water Heaters	404,000	264,000	266,500	122,000	127,500	
A. L-P closed heaters B. H-P closed heaters	401,000	368,500	114,500	112,000		160,5
C. Descrating heater	369,000	358,500	351,000	345,000	342,000	
D. Insulation	303,000	0,0,000	,		,	
1. Closed heaters	25,200	19,500	8,900	3,100		
2'. Deserators	27,200	26,400	25,800	25,400	25,100	
E. Structural work						
 For closed heaters 	31,500	21,000	10,500	10,500		
For deserators	80,000	77,100	75,000	73,500	72,500	
Boiler Feed Pumps						
A. Pumps and base plates	252,000	235,000	227,000	218,000	216,000	210,0
B. Pluid drive	192,000	192,000	192,000	192,000	192,000	192,0
C. Motors	499,000	479,000	450,000	432,000	419,000	424,0
D. Erection	37,000	34,600	33,500	32,300	31,900	31,1
E. Foundation for pumps	11,000	10,300	10,000	9,600	9,500	9,2
Condensate Pumps						
A. Pumps	146,000	94,000	95,000	90,000	95,000	
B. Motors	85,200	53,200	53,800	40,900	42,800	
C. Erection	14,300	13,700	13,800	13,300	13,700	
Piping and Insulation						
A. Extraction steam	7 420 200	559,500	461,100	383,400	324,800	147,9
B. Heater vents and drains	639,300		-	1		
C. Feed water piping	340,000	340,000	211,100	211,100	133,100	260,5
D. Condensate piping	\neg			!		
1. From condensate pumps	196,000	166,000	166,000	166,500	166,500	
through L-P heaters.	130,000	100,000	100,000	200,200	,	
2. To descrator and B.F.	1					
pump suction Z. Main steam	38,200	38,200	35,200	35,200	35,200	35,2
Demineralizing Equipment	251,000	238,000	230,000	224,000	221,000	220,0
and Condensate Storage Tanks		ar- 1	222 42-	004 000	204 200	25/ 2
Electrical	324, 100	315,400	310,600	306,200	306,300	254,9
Turbine Room Building						
	38,027,075	37,604,450	37,117,050	36,928,250	36,978,150	37,074,9
Total Items 1-10	11,874,000		11,874,000	11,874,000	11,874,000	11,874,0
Total Constant Cost		11,874,000		48,802,250	48,852,150	48,948,9
Total Turbine Plant Cost	49,901,075	49,478,450	48,991,050			612,0
	914,000	914,000	617,000	617,000	614,000	
Piping In Containment Vessel Grand Total	50,815,075	50,392,450	49,608,050	49,419,250	49,466,150	49,560,9

SUMMARY OF COST DATA
800 PSIA, 718 F THROTTLE STEAM
(200 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

	1000 8	We INDIRECT CY	CLE TURBINE PLA	NT		
Reater Arrangement	6	5	4	3	2	1
 Turbine Generator and Accesso 	ries					
A. Turbine generator unit	22,570,000	22,570,000	22,570,000	22,570,000	22,570,000	22,570,000
B. Turbine generator erection C. Reserve exciter	700,000	700,000	700,000 CONSTANT	700,000	700,000	700,000
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000
2. Condensers				1	•	•
A. Shells and accessories	2,730,000	2,775,000	2,790,000	2,840,000	2 060 000	2 210 000
B. Dry vacuum pumps	J			í	2,940,000	3,210,000
C. Tubes	1,965,000 28,875	1,980,000	2,010,000	2,055,000	2,115,000	2,310,000
D. Steam jet air equipment E. Erection	429,000	26,250 432,000	26,250 435,000	26,250 443,000	26,250 456,000	42,000 495,000
F. Deseration - hot well of	NONE		100,000	7,000		144,000
cond.						
G. L-P heaters in exhaust star	ck 50,000	50,000	50,000	25,000	25,000	25,000
. Circulating Water System						
A. Structures 1. Crib house						
A. Substructure						
b. Superstructure						
c. Steel						
d. Miscellaneous	928,000	931,000	934,000	944,000	964,000	1,012,000
2. Dredging	ĺ					
 Intake flume or forebay Seal well 						
5. Discharge flume						
6. Outfall				1		
B. Crib house equipment (erect	ed)			1		
1. Traveling screens	223,000	224,000	226 000	230,000	220 000	250 000
 Screen wash pumps Screen wash piping 	> 223,000	224,000	226,000	230,000	239,000	259,000
4. Chlorination equipment						
Chlorine handling)			ſ		
C. Circulating water piping	1,253,000	1,256,000	1,261,000	1,274,000	1,303,000	1,370,000
D. Circulating water pumps 1. Pumps	4ED 000	662 000	667.000	400 000	700 000	****
2. Motors	659,000 382,000	662,000 383,000	667,000 385,000	680,000 390,000	708,000 400,000	773,000 425,000
3. Erection	44,300	44,500	44,700	45,200	46,200	48,500
Feed Water Heaters	•	•	•	['		
A. L-P closed heaters	373,500	244,500	247,000	114,000	119,000	
B. H-P closed heaters	370,500	340,500	163,000	106,000		151,000
C. Deserating heater	351,000	342,000	268,000	264,000	262,400	
D. Insulation 1. Closed heaters	22,800	17,700	10,900	2,900		
2. Deaerators	25,800	25,100	20,000	19,600	19,500	
E Structural Work	•			7		
1.For Closed Heaters	31,500	21,000	10,500	10,500		
2.For Deserators	75,000	72,500	60,000	58,700	58,200	
Boiler Feed Pumps						
A. Pumps and base plates	230,000	219,000	213,000	218,000	203,000	198,000
B. Fluid drive C. Motors	192,000 450,000	192,000 433,000	192,000 412,000	192,000 432,000	192,000 386,000	192,000 393,000
D. Erection	34,300	32,300	31,500	32,300	30,100	29,500
E. Foundation for pumps	10,200	9,600	9,300	9,600	8,900	8,700
Condensate Pumps			•	1.	•	•
A. Pumps	133,000	86,000	87,000	82,000	87,000	
B. Motors	77,900	49,000	49,600	38,000	49,600	
C. Erection	13,500	13,000	13,100	1,2,700	13,100	
Piping and Insulation						
A. Extraction steam	617,100	530,400	442,200	377,100	267,600	147,900
B. Heater vents and drains	1		=	i i		
C. Feed water piping D. Condensate piping	340,000	264,500	211,100	211,100	133,100	260,500
1. From condensate pumps	1			:		
through L-P heaters.	196,000	166,000	166,000	166,500	166,500	
To deserator and B.F.	Į.			i -		
pump suction			25 220	dr. 200	25 200	35 000
E. Main steam	38,200	38,200	35,200	35,200	35,200	35,200
Demineralizing Equipment	231,000	220,000	218,000	208,000	206,000	206,000
and Condensate Storage Tanks						
Electrical	309,100	301,700	297,900	301,500	296,600	243,800
Turbine Room Building						
	36,429,575	35,996,750	35,601,250	35,459,150	35,371,250	35,594,100
rocar rrems rain						11,874,000
	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,0/4,000
Total Items 1-10 Total Constant Cost Total Turbine Plant Cost				47,333,150	47,245,250	
	11,874,000 48,303,575 915,000	11,874,000 47,870,750 782,000	11,874,000 47,475,250 617,000			47,468,100 612,000 48,080,100

SUMMARY OF COST DATA
800 PSIA, 818 F THROTTLE STEAM
(300 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

	Reater Arrangement	- 6	5	4	3	2	1
	Turbine Generator and Accessories	00 ENC 800	00 570 000	99 570 000	22,570,000	22,570,000	22,570,000
1	A. Turbine generator unit B. Turbine generator erection C. Reserve exciter	22,570,000 700,000	22,570,000 700,000	22,570,000 700,000 ——— CONSTANT -	700,000	700,000	700,000
	D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000
1	Condensers A. Shells and accessories	2,550,000	2,565,000	2,610,000	2,655,000	2,790,000	3,000,000
E	B. Dry vacuum pumps		1,860,000	1,875,000	1,920,000	1,995,000	2,150,000
	. Tubes	1,845,000 28,875	26,250	26,250	26,250	26,250	42,000
). Steam jet air equipment 3. Erection	408,000	411,000	414,000	423,000	435,000	463,000
	. Deseration - hot well of	NONE					135,000
G	cond. L-P heaters in exhaust stack	50,000	50,000	50,000	25,000	25,000	25,000
	Circulating Water System Structures 1. Crib house a. Substructure b. Superstructure c. Steel	8h7 400	902,000	907,000	916,000	933,000	974,000
В	d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall 6. Outfall 7. Trush house equipment (erected)	897,000	3029000	701,1000			,
	1. Traveling screens 2. Screen wash pumps 3. Screen wash piping 4. Chlorination equipment 5. Chlorine handling	210,000	212,000	214,000	218,000	225,000	243,000
	. Circulating water piping . Circulating water pumps	1,208,000	1,215,000	1,223,000	1,236,000	1,259,000	1,316,000
_	1. Pumps	616,000	623,000	630,000	642,000	666,000	721,000 405,000
	2. Motors	366,000	369,000	371,000	376,000 43,800	385,000 44,600	46,700
70.	3. Erection	42,800	43,000	43,300	43,000	44,000	,.
	eed Water Heaters . L-P closed heaters	347,500	229,500	233,000	107,000	111,500	142.50
B.	. H-P closed heaters . Descrating heater	345,500 336,000	319,000 262,000	153,000 258,000	101,000 255,000	253,600	143,50
	Insulation 1. Closed heaters 2. Deserators	21,000 24,700	16,500 19,400	10,000 19,000	2,700 18,800	18,700	
E	Structural work 1. For closed heaters	31,500 72,000	21,000 58,100	10,500 56,800	10,\$00 55,700	55,400	
B.c	2. For deserators offer Feed Pumps	, =, 000	,	,	1		
	Pumps and base plates	218,000	205,000	200,000	195,000 192,000	193,000 192,000	189,00 192,00
	Fluid drive	192,000 412,000	192,000 398,000	192,000 378,000	366,000	357,000	367,00
	Motors	32,200	30,600	29,800	29,000	28,700	28,20
	Erection Foundation for pumps	9,600	9,000	8,800	8,700	8,500	8,30
	ondensate Pumps	122,000	79,000	80,000	77,000	80,000	
	Pumps	71,800	45,700	46,200	35,700	37,300	
	Motors Erection	12,900	12,400	12,500	12,200	12,600	
	ping and Insulation Extraction steam	£17 100	520 200	417,000	349,200	266,700	147,9
В.	Heater vents and drains	617,100	520,200		211,100	133,100	260,5
c.	Feed water piping Condensate piping 1. From condensate pumps	264,500	264,500	211,100	211,100		
	through L-P heaters. 2. To deserator and B.F.	196,000	166,000	166,000	154,500	154,500	***
Ĕ.	pump suction	111,200	110,200	110,200	102,700	102,700	102,7
Der	mineralizing Equipment d Condensate Storage Tanks	215,000	205,000	200,000	196,000	194,000	195,00
	ectrical	297,100	290,700	287,900	285,100		234, 10
Tu	rbine Room Building			25 050 250	24 960 050	34,883,950	35,003,9
To	tal Items 1-10	35,786,275	35,345,050	35,058,350	34,860,950		11,874,0
	tal Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	
To				/ c acc	LE TOL OFF	AE 757 050	46 R77 D
To To	tal Turbine Plant Cost ping In Containment Vessel	47,660,275 800,000	47,219,050 775,000	46,932,350 768,000	46,734,950 744,000		46,877,90 741,00

SUMMARY OF COST DATA 800 PSIA, 1000 F THROTTLE STEAM (500 F SUPERHEAT) 1000 MWE INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4		2	1
. Turbine Generator and Accessories A. Turbine generator unit	22,880,000	22,880,000	22,880,000	22,880,000	22,880,000	22,880,000
B. Turbine generator erection	700,000	700,000	700,000 CONSTANT	700,000	700,000	700,000
C. Reserve exciter D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000
. Condensers A. Shells and accessories	2,235,000	2,280,000	2,310,000	2,340,000	2,430,000	2,610,000
B. Dry vacuum pumps C. Tubes	1,605,000	1,635,000	1,665,000	1,693,000	1,755,000	1,890,000
D. Steam jet air equipment	28,875	26,250	26,250	26,250	26,250	42,000
E. Erection	366,000	370,000	375,000	381,000	393,000	415,000
F. Deaeration - hot well of	NONE -	· · · · ·			\longrightarrow	117,000
cond. G. L-P heaters in exhaust stack	50,000	50,000	50,000	25,000	25,000	25,000
. Circulating Water System A. Structures 1. Crib house a. Substructure b. Superstructure						
c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume	\$41,000	847,000	853,000	861,000	875,000	908,000
6. Outfall B. Crib house equipment (erected)				i		
Traveling screens Screen wash pumps Screen wash piping Chlorination equipment	186,000	188,000	191,000	194,000	200,000	215,000
5. Chlorine handling — — C. Circulating water piping	1,130,000	1,138,000	1,147,000	1,158,000	1,176,000	1,225,000
D. Circulating water pumps	540,000	548,000	556,000	567,000	586,000	632,000
1. Fumps 2. Motors	338,000	341,000	344,000	348,000	355,000	372,00
3. Erection	40,000	40,200	40,600	41,000	41,700	43,40
Feed Water Heaters	202 500	204 500	207 500	05.000	99 000	
A. L-P closed heaters	303,500 308,000	204,500 285,500	207,500 137,500	95,000 93,500	99,000	131,00
B. H-P closed heaters C. Descrating heater D. Insulation	249,400	243,000	240,000	237,600	237,000	
1. Closed heaters	17,100	14,400	7,800	2,400		
2. Demerators	18,400	17,900	17,600	17,500	17,400	
E. Structural work	31,500	21,000	10,500	10,500		
 For closed heaters For deaerators 	54,200	52,500	51,600	51,000	50,800	
Boiler Feed Pumps	705 000	195 000	182,000	178,000	177,000	174,00
A. Pumps and base plates	195,000 192,000	185,000 192,000	192,000	192,000	192,000	192,00
B. Fluid drive C. Motors	354,000	344,000	329,000	321,000	315,000	324,00
D. Erection	29,100	27,700	27,200	26,600	26,500	26,10
E. Foundation for pumps	8,600	8,200	8,000	7,800	7,800	7,70
Condensate Pumps						
A. Pumps	105,000	69,000	70,000	68,000	71,000	
B. Motors	62,100 11,800	40,000 11,500	40,600 11,600	31,700 11,400	33,000 11,700	*****
C. Erection	11,500	11,500	11,000	2., 400	,	
Piping and Insulation A. Extraction steam	503 700	502 100	202 000	340 300	233,400	147,90
B. Heater vents and drains	593,700	503,100	393,900	349,200		
C. Feed water piping D. Condensate piping	264,500	264,500	211,100	211,100	133,100	260,50
From condensate pumps through L-P heaters. To deaerator and B.F. pump suction	183,500	149,500	149,500	123,000	123,000	
E. Main steam	167,200	167,200	167,200	167,200	167,200	167,20
Demineralizing Equipment and Condensate Storage Tanks	189,000	183,000	178,000	176,000	175,000	176,00
Electrical	277,400	272,800	270,900	268,800	269,400	217,80
Turbine Room Building						
Total Items 1-10	34,899,875	34,644,750	34,386,350	34,201,550	34,127,250	34,243,60
	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,00
Total Constant Coer	11,0/4,000					
Total Constant Cost						
Total Constant Cost Total Turbine Plant Cost Piping In Containment Vessel	46,773,875	46,518,750 1,092,000	46,260,350 1,083,000	46,075,550 1,083,000	46,001,250 1,073,000	46,117,600 1,083,000

SUMMARY OF COST DATA
600 PSIA, 486 F THROTTLE STEAM
(SATURATED STEAM)
1000 MMe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	. 5	4 .	3 ''	2	- r
. Turbine Generator and Accessories					
A. Turbine generator unit	21,500,000	21,500,000	21,500,000	21,500,000	21,500,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	345,000	3,45 000	CONSTANT -	365.000	2/5 000
D. Turbine foundation	545,000	345,000	345,000	345,000	345,000
. Condensers					
A. Shells and accessories	3,336,000	3,420,000	3,525,000	3,660,000	3,900,000
B. Dry vacuum pumps C. Tubes	2,405,000	2,451,000	2,532,000	2,620,000	2,790,000
D. Steam jet air equipment	23,625	23,625	21,000	21,000	31,500
E. Breccion	510,000	513,000	528,000	550,000	580,000
F. Deseration - hot well of	none ——	· · · · · · · · · · · · · · · · · · ·			175,000
cond.					
G. L-P heaters in exhaust stack	50,000	50,000	25,000.	25,000	25,000
Circulating Water System A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging	1,038,000	1,049,000	1,068,000	1,090,000	1,130,000
3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall 1. Traveling acreens 2. Screen wash pumps 3. Screen wash piping 4. Chlorination equipment	270,000	276,000	284,000	293,000	310,000
5. Chlorine handling C. Circulating water piping	1,406,000	1,422,000	1,449,000	1,480,000	1,536,000
D. Circulating water pumps 1. Fumps	808,000	824,000	850,000	879,000	935,000
2. Motors	437,000	443,000	453,000	464,000	485,000
3. Erection	49,800	50,500	51,400	52,500	54,500
Feed Water Heaters					
A. L-P closed heaters	337,000	344,000	175,000	182,000	
B. H-P closed heaters	434,000	200,000	183,500	24- 420	212,000
C. Deserating heater	393,000	382,500	372,600	367,500	
D. Insulation 1. Closed heaters	23,400	13,900	6,000		
2. Deserators	29,100	28,200	27,500	27,100	
E. Structural work	- •		• •	·	
 For closed heaters 	21,000	10,500	10,500		
2. For deserators	87,000	83,800	81,300	79,500	
Boiler Feed Pumps					
A. Pumps and base plates	233,000	222,000	214,000	209,000	206,000
B. Fluid drive	192,000	192,000	192,000	192,000	192,000
C. Motors	375,000	347,000	346,000	329,000	351,000
D. Brection	36,200 12,000	34,700	33,600	32,500 10,800	32,300 10,700
E. Foundation for pumps	12,000	11,500	11,100	10,000	10,700
Condensate Pumps	127 000	1.60 000	107 000	112 000	
A. Pumps B. Motors	137,000 71,000	140,000 72,000	107,000 47,300	112,000 49,300	
B. Motors C. Brection	15,200	15,300	14,700	15,100	
	·= • = · ·		•	- •	
Piping and Insulation A. Extraction steam		200	057 000	A17 555	124
B. Heater vents and drains	483,900	398, 100	357,000	216,900	103,500
C. Feed water piping C. Condensate piping	281,700	261,300	179,500	109,800	227,500
1. From condensate pumps through L-F heaters. 2. To deaerator and B.F. pump suction	203,500	203,500	185,800	185,800	
3. Main steam	71,000	69,000	67,000	65,000	65,000
Pemineralizing Equipment and Condensate Storage Tanks	278,000	266,000	256,000	249,000	245,000
Electrical	307,900	302,900	301,200	300,600	250,200
Furbine Room Building					
Total Items 1-10	36,900,325	36,665,325	36,500,000	36,412,400	36,492,200
Total Constant Cost	11,874,000 48 774 325	11,874,000 48 539 325	11,874,000	11,874,000 48 286 400	11,874,000 48,266,200
fotal Turbine Plant Cost	48,774,325 766,000	48,539,325 675,000	48,374,000 624,000	48,286,400 604,000	599,000
	100,000	013,000	U44, UU	004,000	277,000
Piping In Containment Vessel Grand Total	49,540,325	49,214,325	48,998,000	48,890,400	48,865,200

SUMMARY OF COST DATA
600 PSIA, 586 F THROTTLE STEAM
(100 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Select Arrangement 3			RECT CYCLE TURBI	NE PLANT		
A. Turbins generator unit 2, 1,020,000 21,020,000 21,020,000 21,020,000 21,020,000 20,000 20,000 21,000,000 21	Heater Arrangement	5	4	3		1.
D. Turbine foundation 345,000	A. Turbine generator unit B. Turbine generator exection			700,000		21,020,000 700,000
A. Shells and accessories B. Dry vaccumpumps C. Tubes C.	D. Turbine foundation	345,000	345,000		345,000	345,000
3. Citroulating Water System A. Structures 1. Crib house a. Substructure b. Superatructure b. Superatructure b. Superatructure b. Superatructure d. Miscellaneous 2. Decedging 3. Intake flume or forebay 4. Seal well 3. Diackse flume 3. Intake flume or forebay 4. Seal well 3. Diackse flume 5. Cith house equipment (erected) 1. Traveling screen 2. Sereen wash plumps 3. Sereen wash plumps 3. Sereen wash plumps 3. Chilorine headling 5. Chilorine headling 1. Judy 5. Chilorine headling 5. Chilorine headling 1. Judy 5. Chilorine headling 5. Chilorine headling 1. Judy 5. Chilorine headling 1. Judy 5. Chilorine headling 1. Judy 5. Chilorine headling 1. Judy 5. Chilorine headling 1. Judy 5. Chilorine headling 1. Judy 5. Chilorine headling 1. Judy 5. Chilorine headling 1. Judy 5. Chilorine headling 1. Judy 5. Chilorine headling 1. Judy 5. Chilorine headling 1. Judy 5. Chilorine headling 1. Judy 5. Chilorine headling 1. Judy 1	A. Shells and accessories B. Dry vacuum pumps C. Tubes D. Steam jet air equipment E. Erection F. Descration - hot well of	2,235,000 23,625 481,000	2,265,000 23,625	2,315,000 21,000	2,385,000 21,000	2,556,000 31,500 535,000
A. Structures 1. Crib house 2. Designs 3. Intake flume or forebay 4. Miscellaneous 2. Designs 3. Intake flume or forebay 4. Saal well 3. Discharge flume 5. Superatructure 4. Miscellaneous 2. Designs 3. Intake flume or forebay 4. Saal well 3. Discharge flume 5. Crib house equipment (erected) 1. Traveling screens 2. Screen wash pumps 3. Screen wash piping 4. Chlorination equipment 5. Criculating water piping 6. Circulating water piping 1. Ja46,000 1. Jay 1000	G. L-P heaters in exhaust stack	50,000	50,000	25,000	25,000	25,000
2. Screen wash pumps 3. Screen wash pining 4. Chlorinaction equtyment 5. Chlorine handling C. Cfrculating water piping D. Cfrculating water piping 1. Yumps 1. Yumps 2. Mctoras 1. Yumps 2. Mctoras 1. Yumps 1. Yumps 2. Mctoras 3. Exection 3. Exection 4. CP closed heaters A. L-P closed heaters A. L-P closed heaters 310,500 314,000 314,000 315,000 314,000 316,000 314,000 316,000 314,000 316,000 314,000 316,000 314,000 316,	A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall B. Crib house equipment (erected)	999,000	1,004,000	1,014,000	.1,033,000	1,074,000
D. Circulating water pumps 1. Pumps 2. Hotors 2. Hotors 3. Frection 47,700 48,200 421,000 426,000 436,000 437,000 44,000	2. Screen wash pumps 3. Screen wash piping 4. Chlorination equipment	252,000	256,000	260,000	268,000	286,000
2. Motors	D. Circulating water pumps					
3. Erection 47,700 48,200 48,700 49,700 51,700 4. Feed Water Heaters A. LP closed heaters 310,500 314,000 158,000 165,000 B. H.P closed heaters 306,500 180,000 354,000 349,000						
A. L-P closed heaters 336,500 180,000 167,000 194,500 C. Deaerating heater 370,500 360,600 354,000 349,500 194,500 C. Deaerating heater 370,500 360,600 354,000 349,500 194,500 C. Deaerating heater 21,000 12,500 5,400 194,500 C. Deaerators 21,000 12,500 5,400 194,500 C. Deaerators 27,300 26,500 26,000 25,700 194,500 C. Deaerators 27,300 26,500 26,000 25,700 194,500 C. Deaerators 80,500 77,900 75,800 74,500 194,500 C. Deaerators 80,500 77,900 75,800 74,500 194,500 C. Deaerators 80,500 77,900 75,800 74,500 C. Deaerators 192,000 192,0						
2. Descrators E. Structural work 1. For closed heaters 2. 1,000 10,500 77,900 75,800 74,500 5. Boiler Feed Pumps A. Pumps and base plates 211,000 202,000 192,0	A. L-P closed heaters B. H-P closed heaters C. Deaerating heater D. Insulation	386,500 370,500	180,000 360,600	167,000 354,000	349,500	194,500
5. Boiler Feed Pumps A. Pumps and base plates B. Fluid drive 192,000 192,000 192,000 192,000 192,000 192,000 192,000 192,000 192,000 192,000 192,000 192,000 192,000 192,000 192,000 192,000 192,000 394,000 377,000 399,000 5. Frendation for pumps 11,000 10,500 10,200 10,000 9,900 6. Condensate Pumps A. Pumps 123,000 125,000 14,300 125,000 14,300 14,200 1 7. Fiping and Insulation A. Extraction steam B. Heater vents and drains C. Feed water piping 1. From condensate pumps through LP heaters. 2. To deaerstor and B.F. pump sauction E. Hadin steam 58,700	E. Structural work	21,000	10,500	10,500		
A. Pumps and base plates B. Fluid drive B. Fluid B. Fluid B. Fluid drive B. Fluid B.		80,500	77,900	75,800	74,500	
C. Motors D. Erection D. Erection S. 33,000 S. Foundation for pumps S. 11,000 S. Foundation for pumps S. 123,000 S. Foundation for pumps S. 123,000 S. Foundation for pumps S. 123,000 S. Foundation for pumps S. 123,000 S. Foundation for pumps S. 123,000 S. Foundation for pumps S. 123,000 S. Foundation for pumps S. 64,000 S. 65,200 S. 64,000 S. Foundation S. Erection S. Freetion S. Foundation S. Erection S. Foundation S. Erection S. Foundation S. Erection S. Foundation S. Erection S. Foundation S. Erection S. Foundation S. Erection S. Foundation S. Erection S. Foundation	A. Pumps and base plates					
D. Erection E. Foundation for pumps 11,000 10,500 10,200 10,000 9,900 6. Condensate Pumps A. Pumps B. Motors C. Erection 12,000 14,200 14,300 13,800 10,000 9,900 6. Condensate Pumps A. Pumps 123,000 65,200 143,100 144,800 1 7. Piping and Insulation A. Extraction steam A. Extraction steam B. Heater vents and drains C. Feed water piping D. Condensate piping 1. From condensate pumps through L-P heaters. 2. To deaerator and B.F. pump suction E. Main steam 58,700 58,						
E. Foundation for pumps						
A. Pumps B. Motors C. Erection 14,200 14,300 13,800 14,200 14,300 14,200 1 7. Piping and Insulation A. Extraction steam B. Heater vents and drains C. Feed water piping D. Condensate piping 1. Prom condensate pumps through L-P heaters. 2. To deareator and B.F. pump suction E. Main steam 3. Demineralizing Equipment and Condensate Storage Tanks 9. Electrical 310,600 305,800 303,100 302,600 252,500 303,400 303,400 303,900		11,000				
B. Motors C. Erection C. Erection C. Erection 14,200 14,300 13,800 14,200 7. Piping and Insulation A. Extraction steam A. Extraction steam B. Heater vents and drains C. Feed water piping C. F		100 000	105 000	05 000	100,000	
C. Erection 14,200 14,300 13,800 14,200 7. Piping and Insulation A. Extraction steam B. Hatter vents and drains C. Feed water piping D. Condensate piping 1. From condensate pumps through L-P heaters. 2. To dearetor and B.F. pump suction E. Main steam 58,700 58,700 58,700 58,700 58,700 58,700 8. Demineralizing Equipment and Condensate Storage Tanks 9. Electrical 310,600 305,800 303,100 302,600 227,000 10. Turbine Room Building Total Items 1-10 35,657,725 35,313,625 35,164,100 34,993,400 35,034,200 Total Turbine Plant Cost 47,531,725 47,187,625 47,038,100 46,867,400 46,908,200 Tiping In Containment Vessel 716,000 590,000 591,000 581,000 591,000 5				43,100		
A. Extraction steam B. Heater vents and drains C. Feed water piping D. Condensate piping 1. From condensate pumps through L-P heaters. 2. To descrator and B.F. pump suction E. Main steam S. Demineralizing Equipment and Condensate Storage Tanks 9. Electrical 310,600 305,800 303,100 302,600 303,000 227,000 300,000 228,000 227,000 300,000 3						
B. Heater vents and drains C. Feed water piping D. Condensate piping 1. From condensate pumps through LP heaters. 2. To deserator and B.F. pump suction E. Main steam 58,700 58		493 000	208 100	257 000	216 000	102 500
1. From condensate pumps through L-P heaters. 2. To deserator and B.F. pump suction E. Main steam 58,700 58	C. Feed water piping					
E. Main steam 58,700 58	1. From condensate pumps through L-P heaters. 2. To deaerstor and B.F.	166,000	166,000	166,500	166,500	
8. Demineralizing Equipment 253,000 242,000 234,000 228,000 227,000 and Condensate Storage Tanks 9. Electrical 310,600 305,800 303,100 302,600 252,500 10. Turbine Room Building		58,700	58,700	58,700	58,700	58,700
9. Electrical 310,600 305,800 303,100 302,600 252,500 10. Turbine Room Building Total Items 1-10 35,657,725 35,313,625 35,164,100 34,993,400 35,034,200 Total Constant Cost 11,874,000 1	8. Demineralizing Equipment	253,000	242,000	;	228,000	227,000
Total Items 1-10 35,657,725 35,313,625 35,164,100 34,993,400 35,034,200 Total Constant Cost 11,874,000 11,874,000 11,874,000 11,874,000 11,874,000 Total Turbine Plant Cost 47,531,725 47,187,625 47,038,100 46,867,400 46,908,200 11. Piping In Containment Vessel 716,000 590,000 591,000 585,000 591,000 591,000	9. Electrical					
Total Constant Cost 11,874,000 11						
Total Turbine Plant Cost 47,531,725 47,187,625 47,038,100 46,867,400 46,908,200 11. Piping In Containment Vessel 716,000 590,000 591,000 595,000 591,000 591,000 77,452,400 47,469,200				1		
11. Piping In Containment Vessel 716,000 590,000 591,000 585,000 591,000 591,000 7,155,000 7,000,200						
10 017 705		716,000	590,000	591,000	585,000	591,000
		48,247,725	47,777,625		47,452,400	47,499,200

SUMMARY OF COST DATA
600 FSIA, 686 F THROTTLE STEAM
(200 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE FLANT

	1000 MWe INDIE				
Heater Arrangement	5	4	3	2	i
A. Turbine Generator and Accessories A. Turbine generator unit	20,380,000	20,380,000	20,380,000	20,380,000	20,380,000 700,000
B. Turbine generator erection C. Reserve exciter	700,000	700,000	700,000 ——— Gonstant —		
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000
. Condensers A. Shells and accessories	2,900,000	2,940,000	2,985,000	3,060,000	3,300,000
B. Dry vacuum pumps	2,085,000	2,112,000	2,136,000	2,214,000	2,370,000
C. Tubes D. Steam jet air equipment	23,625	.23,625	21,000	21,000	31,500
E. Erection	454,000	459,000	464,000	478,000	505,000
F. Descration - hot well of	none——				148,000
cond. G. L-P heaters in exhaust stack	50,000	50,000	25,000	25,000	25,000
Circulating Water System A. Structures 1. Crth house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall	959,000	965,000	976,000	991,000	1,027,000
B. Crib house equipment (erected) 1. Traveling screens					
2. Screen wash pumps 3. Screen wash piping 4. Chlorination equipment	237,000	239,000	242,000	250,000	266,000
5. Chlorine handling C. Circulating water piping	1,296,000	1,304,000	1,314,000	1,340,000	1,392,000
D. Circulating water pumps	701,000	709,000	719,000	743,000	795,000
1. Pumps 2. Motors	398,000	400,000	404,000	414,000	433,000
3. Erection	45,900	46,200	46,600	47,500	49,300
Feed Water Heaters A. L-P closed heaters	288,500	290,500	147,000	153,000	
B. H-P closed heaters	356,000	166,000	154,500		181,000
C. Deaerating heater D. Insulation	353,400	345.000	339,000	268,000	
1. Closed heaters	19,200	11,500	4,900	20,000	******
2. Deserators E. Structural Work	26,000	25,400	24,900	20,000	
1. For Closed Heaters	21,000	10,500	10,500		
2. For Deaerators	75,600	73,500	71,900	60,000	
Boiler Feed Pumps A. Pumps and base plates	193,000	188,000	184,000	180,000	180,000
A. Fluid drive	192,000	192,000	192,000	192,000	192,000
C. Motors	387,000	362,000	361,000	348,000	368,000
D. Erection	30,700	29,500	28,800	28,300	28,200 9,400
E. Foundation for pumps	10,200	9,800	9,600	9,400	9,400
Condensate Pumps	112,000	113,000	87,000	92,000	
A. Pumps B. Motors	59,500	60,000	39,900	41,600	
C. Erection	13,500	13,600	13,100	13,500	
Piping and Insulation A. Extraction steam	476,100	390,900	347,700	207,600	103,500
B. Heater vents and drains	310,700	233,500	233,500	122,200	248,000
C. Feed water piping D. Condensate piping 1. From condensate pumps					
through L-P heaters. 2. To deserator and B.P.	166,000	166,000	166,500	166,500	
pump suction	71,700	71,700	58,700	58,700	58,700
Demineralizing Equipment and Condensate Storage Tanks	233,000	224,000	217,000	214,000	212,000
Electrical	297,800	293,400	291,500	291,100	240,800
Turbine Room Building					
Total Items 1-10	34,267,425	33,942,625	33,740,600	33,474,400	33,588,400
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Gost	46,141,425	45,816,625	45,614,600	45,348,400	45,462,400
Piping In Containment Vessel	753,000	625,000	588,000	583,000 45,931,400	592,000 46,054,400
	46,894,425	46,441,625	46,202,600		

SUMMARY OF COST DATA
600 PSIA, 886 P THROTTLE STEAM
(400 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	5	4	3	2	1
1. Turbine Generator and Accessories	20 700 500	00 700 000	20 700 00	10 700 000	00 Tán
A. Turbine generator unit	20,700,000 700,000	20,700,000 700,000	20,700,000 700,000	20,700,000 700,000	20,760,00 700,00
 B. Turbine generator erection C. Reserve exciter 	7001000	700,000	CONSTANT -	700,000	700,00
D. Turbine foundation	345,000	345,000	345,000	345,000	345,00
2. Condensers					
A. Shells and accessories	2,525,000	2,550,000	2,610,000	2,700,000	2,900,00
B. Dry vacuum pumps			i		
C. Tubes	1,821,000	1,842,000	1,878,000	1,964,000	2,080,00
D. Steam jet air equipment	28,875	28,875	26,250	26,250	34,12
E. Erection	407,000 NONE ——	410,000	417,000	428,000	453,00
F. Deseration - hot well of	HORE				130,00
G. L-P heaters in exhaust stack	50,000	50,000	25,000	25,000	25,00
. Circulating Water System					
A. Structures					
1. Crib house					
a. Substructure					
b. Superstructure					
c. Steel	904 000	000 000	000 000	024 000	057.00
d. Miscellaneous	894,000	900,000	908,000	924,000	957,00
2. Dredging					
3. Intake flume or forebay 4. Seal well			- 1		
5. Discharge flume					
6. Outfall					
B. Crib house equipment (erected)			:		
1. Traveling screens	*** ***				004 00
2. Screen wash pumps	209,000	211,000	214,000	221,000	236,00
3. Screen wash piping					
4. Chlorination equipment 5. Chlorine handling			į		
G. Circulating water piping	1,204,000	1,213,000	1,224,000	1,246,000	1,293,00
D. Circulating water pumps	-,	-,,	,	-,,	.,
1. Pumps	612,000	620,000	630,000	653,000	698,00
2. Motors	365,000	367,000	372,000	380,000	397,00
3. Erection	42,600	42,900	43,300	44,200	45,80
Feed Water Heaters					
A. L-P closed heaters	252,000	254,500	129,500	134,000	
B. H-P closed heaters	309,000	143,000	135,500		160,50
C. Deaerating heater	261,000	255,000	251,000	248,400	
D. Insulation 1. Closed heaters	16,500	10,000	4,300		
2. Deserators	19,400	18,800	18,500	18,300	
E. Structural Work	-2,	,	,2	,	
1. For Closed Heaters	21,000	10,500	10,500		
 For Deaerators 	57,800	56,000	54,800	54,200	
Boiler Feed Pumps			!		
A. Pumps and base plates	173,000	167,000	161,000	158,000	155,00
B. Fluid drive	192,000	192,000	192,000	141,000	192,00
C. Motors	329,000	310,000	301,000	291,000	301,00
D. Brection	27,200	26,400	25,300	29,000	24,50
E. Foundation for pumps	9,100	8,800	8,400	8,300	8,10
Condensate Pumps					
A. Pumps	96,000	97,000	75,000	78,000	
B. Motors	51,400	51,800	35,000	36,300 12,400	
C. Erection	12,300	12,400	12,100	12,400	
Piping and Insulation			i		
A. Extraction steam	448,200	362,400	299,700	179,400	103,500
B. Heater vents and drains	246,000	233,500	233,500	122,200	248,000
C. Feed water piping D. Condensate piping	=70,000	224,500	=55,500		240,000
1. From condensate pumps			İ		
through L-P heaters.	166,000	166,000	154,200	154,200	
2. To deserator and B.F.					
pump suction	140.000	140,000	140 000	160 000	140 000
E. Main steam	140,000	140,000	140,000	140,000	140,000
Demineralizing Equipment	204,000	197,000	192,000	188,000	190,000
and Condensate Storage Tanks			!		
Electrical	277,400	274,400	271,200	271,600	219,400
Turbine Room Building					
	33,211,775	32,966,275	32,797,050	32,620,750	32,735,925
Total Items I-10					
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	45,085,775	44,840,275	44,671,050	44,494,750	44,609,925
Piping In Containment Vessel Grand Total	789,000 45,874,775	785,000 45,625,275	785,000 45,456,050	773,000 45,267,750	667,000 45,276,925

600 PSIA, 986 F THROTTLE STEAM (500 F SUPERHEAT) 1000 MWW INDIRECT CYCLE TURBINE PLANT

	1000 kme INDI	RECT CYCLE TORBIN		,	
Heater Arrangement	5	4	3	2	1
Turbine Generator and Accessories A. Turbine generator unit B. Turbine generator erection C. Paccerus creditor	21,180,000 700,000	21,180,000 700,000	21,180,000 700,000 ——————————————————————————	21,180,000 700,000	21,180,000
C. Reserve exciter D. Turbine foundation	345,000	345,000	345,000	345,000	345,000
A. Shells and accessories B. Dry vacuum pumps	2,360,000	2,400,000	2,415,000	2,520,000	2,700,000
C. Tubes D. Steam jet air equipment E. Brection F. Deaerstion - hot well of	1,704,000 28,875 385,000 NONE	1,728,000 28,875 390,000	1,755,000 26,250 394,000	1,812,000 26,250 405,000	1,964,000 34,125 428,000 122,000
cond. G. L-P heaters in exhaust stack	50,000	50,000	25,000	25,000	25,000
Circulating Water System A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscallaneous 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall B. Crib house equipment (erected)	865,000	871,000	878,000	892,000	923,000
Traveling screens Screen wash pumps Screen wash piping Chlorination equipment	196,000	199,000	202,000	208,000	221,000
5. Chlorine handling C. Circulating water piping D. Circulating water pumps	1,164,000	1,172,000	1,182,000	1,201,000	1,245,000
1. Pumps	572,000	580,000	590,000	608,000	652,000
2. Motors 3. Erection	350,000 41,200	353,000 41,500	356,000 41,800	363,000 42,500	380,000 44,100
. Feed Water Heaters	41,200	42,500	42,000	42,500	,
A. L-P closed heaters	238,000	240,000	123,000	127,000	
B. H-P closed heaters	290,500	136,000	128,000	240.000	152,000
C. Deaerating heater D. Insulation 1. Closed heaters	251,600 12,900	246,000 9,400	242,400 4,000	240,000	
2. Deserators	18,500	18,100	17,800	17,600	
E. Structural work 1. For closed heaters	21,000	10,500	10,500		
2. For deserators	55,000	53,400	52,300	51,800	
. Boiler Feed Pumps	164 000	150.000	152 000	151 000	140 000
A. Pumps and base plates B. Fluid drive	164,000 192,000	159,000 141,000	152,000 141,000	151,000 141,000	148,000 141,000
C. Motors	306,000	283,000	270,000	258,000	266,000
D. Erection	25,800	25,100	24,200	23,900	23,500
E. Foundation for pumps	8,600	8,300	8,000	8,000	7,800
. Condensate Pumps A. Pumps	89,000	90,000	70,000	73,000	
B. Motors	48,000	48,500	32,900	34,100	
C. Erection	11,900	11,900	11,600	11,900	
Piping and Insulation A. Extraction steam	448,200	362,400	299,700	179,400	103,500
B. Heater vents and drains C. Feed water piping D. Condensate piping	246,000	233,500	233,500	122,200	248,000
1. From condensate pumps through L-P heaters.	154,000	154,000	150,000	150,000	n =
2. To deaerstor and B.F.		168,200	168,200	168,200	168,200
pump suction B. Main steam	168,200		1		
pump suction B. Main steam Demineralizing Equipment and Condensate Storage Tanks	192,000	186,000	182,000	179,000	181,000
pump suction B. Main steam Demineralizing Equipment and Condensate Storage Tanks Electrical			182,000 263,500	179,000 263,700	181,000 211,900
pump suction B. Main steam Demineralizing Equipment and Condensate Storage Tanks	192,000 268,800	186,000 266,200	263,500	263,700	211,900
pump suction E. Main steam Demineralizing Equipment and Condensate Storage Tanks Electrical Turbine Room Building	192,000 268,800 33,151,075 11,874,000	186,000 266,200 32,888,875 11,874,000	263,500 32,674,650 11,874,000	263,700 32,527,550 11,874,000	211,900 32,614,125 11,874,000
pump suction E. Main steam Demineralizing Equipment and Condensate Storage Tanks Electrical Turbine Room Building Total Items 1-10	192,000 268,800 33,151,075	186,000 266,200 32,888,875	263,500 32,674,650	263,700 32,527,550	211,900 32,614,125

SUMMARY OF COST DATA
400 PSIA, 445 F THROTTLE STEAM
(SATURATED STEAM)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	4	3	2	<u> </u>
. Turbine Generator and Accessories	80 100 000	46 100 000	20 100 000	20 100 000
A. Turbine generator unit B. Turbine generator erection C. Reserve exciter	28,100,000 1,040,000		28,100,000 1,040,000 TANT ———————————————————————————————————	21,648,888
D. Turbine foundation	460,000	460,000	460,000	460,000
Condensers A. Shells and accessories	3,680,000	3,720,000	3,790,000	4,040,000
B. Dry vacuum pumps			1	2,940,000
C. Tubes	2,720,000 31,500	2,770,000 28,000	2,780,000	35,000
D. Steam jet air equipment	580,000	584,000	592,000	624,000
E. Erection F. Deseration - hot well of	NONE -	337,000		180,000
cond. G. L-P heaters in exhaust stack	56,000	28,000	28,000	28,000
Circulating Water System			•	
A. Structures 1. Crib house				
a. Substructure				
b. Superstructure c. Steel				
d. Miscellaneous	1,093,000	1,100,000	1,112,000	1,157,00
2. Dredging				
 Intake flume or forebay 			1	
4. Seal well				
5. Discharge flume			1	
6. Outfall B. Crib house equipment (erected)				
1. Traveling screens			1	
2. Screen wash pumps	295,000	297,000	303,000	324,00
 Screen wash piping 				
4. Chlorination equipment			į	
5. Chlorine handling	1 400 000	1,495,000	1,512,000	1,578,00
C. Circulating water piping D. Circulating water pumps	1,488,000	1,493,000	1,512,000	.,0,.,
1. Pumps	886,000	894,000	911,000	973,00
2. Motors	466,000	470,000	476,000	499,00
3. Erection	52,700	53,000	53,700	56,00
Feed Water Heaters A. L-P closed heaters	416,000	175,000	180,000	
B. H-P closed heaters	212,000	241,000		206,00
C. Deaerating heater	460,000	448,800	439,200	
D. Insulation	12,800	6,200	*****	*****
1. Closed heaters 2. Deserators	33,800	33,000	32,200	
E. Structural Work	55,000			
1. For Closed Heaters	14,000	-14,000		
2. For Deaerators	98,000	95,200	92,000	
Boiler Feed Pumps	250 200	22/ 000	224,000	210,00
A. Pumps and base plates	252,000 188,000	234,000 188,000	188,000	188,00
B. Fluid drive	288,000	290,000	268,000	284,00
C. Motors D. Erection	37,600	35,200	34,000	32,20
E. Foundation for pumps	14,200	13,400	12,800	12,20
Condensate Pumps				
A. Pumps	164,000	124,000	128,000	
B. Motors	99,000	59,400	61,000	
C. Erection	18,600	17,400	17,800	
Piping and Insulation A. Extraction ateam	450,000	445,000	170,600	162,40
3. Heater vents and drains	452,000		1	
C. Feed water piping	210,000	210,000	80,000	176,00
Condensate piping				
1. From condensate pumps	239,000	206,400	218,800	
through L-P heaters. 2. To deaerator and B.F.	,	•		
pump suction		100.000	00.000	98,00
. Main steam ◆	107,000	102,000	98,000	
emineralizing Equipment	444,000	436,000	422,000	412,00
nd Condensate Storage Tanks	334,000	329,400	327,800	276,00
Rectrical Curbine Room Building				
	45,042,200	44,742,400	44,179,900	44,090,80
Cotal Items 1-10	12,676,000	12,676,000	12,676,000	12,676,00
otal Constant Cost	57,718,200	57,418,400	56,855,900	56,766,80
otal Turbine Plant Cost Piping In Containment Vessel	891,000	840,000	786,000	759,00
			57,641,900	57,525,80

SUMMARY OF COST DATA
400 PSIA, 545 F THROTTIE STEAM
(100 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	4	3	2	1
. Turbine Generator and Accessories	27 200 000	27,380,000	27,380,000	27,380,000
A. Turbine generator unit	27,380,000 1,000,000	1,000,000	1,000,000	1,000,000
B. Turbine generator erection	1,000,000	CONSTANT -	1,000,000	
C. Reserve exciter D. Turbine foundation	460,000	460,000	460,000	460,000
. Condensers A. Shells and accessories	3,380,000	3,400,000	3,508,000	3,550,000
B. Dry vacuum pumps			1 ' '	2,760,000
C. Tubes	2,440,000	2,460,000	2,530,000 28,000	35,000
D. Steam jet air equipment	31,500 540,000	28,000 544,000	554,000	586,000
E. Erection F. Descration - hot well of	NONE -			160,000
cond.			90,000	28,000
G. L-P heaters in exhaust stack	56,000	28,000	28,000	20,000
Circulating Water System A. Structures 1. Crib house a. Subestructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal well	1,042,000	1,047,000	1,060,000	1,108,000
5. Discharge flume 6. Outfall B. Crib house equipment (erected) 1. Traveling screens 2. Screen wash pumps 3. Screen wash piping	272,000	274,000	280,000	298,00
4. Chlorination equipment 5. Chlorine handling				
C. Circulating water piping D. Circulating water pumps	1,413,000	1,420,000	1,440,000	1,500,00
1. Pumps	813,000	820,000	842,000	899,00 472,00
2, Motors	440,000	442,000 50,300	450,000 51,100	53,20
3. Erection	50,100	50,500	22,222	
. Feed Water Heaters A. L-P closed heaters	374,000	160,000	164,000	
B. H-P closed heaters	191,000	215,000	420,000	189,00
C. Deserating heater	436,000	427,200	420,000	
D. Insulation 1. Closed heaters	11,600	5,600		
2. Deaerators	32,000	31,400	31,000	
E. Structural work				
 For closed heaters 	14,000	14,000	87,200	
2. For deserators	91,400	89,200	07,200	
. Boiler Feed Pumps	228,000	212,000	206,000	194,0
A. Pumps and base plates	188,000	188,000	188,000	188,0
B. Fluid drive C. Motors	368,000	364,000	342,000	350,0
D. Erection	34,600	32,600	31,600	30,2
E. Foundation for pumps	13,000	12,400	12,000	11,4
. Condensate Pumps		*** ***	116 000	
A. Pumps	147,000	112,000 54,400	116,000 56,200	
B. Motors	89,600 17,000	16,000	16,400	
C. Erection	2,,000			
Piping and Insulation A. Extraction steam	453 000	445,000	170,600	162,4
B. Heater vents and drains	452,000			254,4
C. Feed water piping D. Condensate piping	272,600	272,600	122,600	2,34,4
1. From condensate pumps through L-P heaters. 2. To deserator and B.F.	208,800	188,000	188,000	
pump suction	62,400	62,400	62,400	62,4
Demineralizing Equipment	414,000	402,000	390,000	384,0
and Condensate Storage Tanks	338,600	332,800	331,400	281,2
. Electrical		JJE, 000		
. Turbine Room Building	~			
Total Items 1-10	43,301,200	42,989,900	42,546,500	42,396,2 12,676,0
Total Constant Cost	12,676,000	12,676,000	12,676,000	55,072,2
Total Turbine Plant Cost	55,977,200	55,665,900 732,000	610,800	610,8
. Piping In Containment Vessel	752,100 56,729,300	56,397,900	55,833,300	55,683,0
Grand Total				

SUMMARY OF COST DATA
400 PSIA, 645 F THROTTLE STEAM
(200 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	4	3	. 2	1
Turbine Generator and Accessories A. Turbine generator unit B. Turbine generator erection	26,900,000 1,080,000	26,900,000 1,080,000	26,900,000 1,080,000	26,900,000 1,080,000
C. Reserve exciter D. Turbine foundation	560,000	CONSTANT 560,000	560,000	560,000
2. Condensers A. Shells and accessories	3,156,000	3,200,000	3,310,000	3,540,000
B. Dry vacoum pumps	2,234,000	2,268,000	2,340,000	2,562,000
C. Tubes	31,500	28,000	28,000	35,000
D. Steam jet air equipment E. Brection	510,000	514,000	530,000	562,000
F. Deaeration - hot well of	NONE -			159,400
cond. G. L-P heaters in exhaust stack	56,000	28,000	28,000	28,000
A. Structures A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous	1,000,000	1,010,000	1,028,000	1,070,000
2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Ourfall B. Crib house equipment (erected) 1. Traveling screens	254,000	257,500	266,000	284,000
2. Screen wash pumps 3. Screen wash piping 4. Chlorination equipment	254,000		·	
5. Chlorine handling C. Circulating water piping D. Circulating water piping	1.353,000	1,366,000	1,394,000	1,450,000
D. Circulating water pumps 1. Pumps	/55,000	768,000	793,000	850,000
2. Motors	418,000	422,000	433,000 49,400	454,000 51,500
3. Erection	48,000	*48,400	19,100	
4. Feed Water Heaters A. L-P closed heaters	344,000	149,000	154,000	166 000
B. H-P closed heaters C. Deaerating heater	175,000 418,000	183,000 409, 6 00	404,000	166,000
D. Insulation 1. Closed heaters	10,800	5,000		
2. Deserators B. Structural work	30,800	30,200	29,800	
1. For closed heaters	14,000	14,000	82,200	
For deaerators	86,800	84,800	02,200	
. Boiler Feed Pumps	210,000	196,000	190,000	172,000
A. Pumps and base plates	188,000	188,000	188,000	188,000
B. Fluid drive C. Motors	336,000	330,000	314,000	304,000
D. Erection	32,800	30,400	29,800 11,400	27,600 10,400
E. Foundation for pumps	12,200	11,600	11,400	,
. Condensate Pumps	134,000	103,000	107,000	= = =
A. Pumps	82,600	51,000	52,600	
B. Motors C. Erection	15,600	14,800	15,400	
7. Piping and Insulation A. Extraction steam	450,000	445,000	264,000	162,000
B. Heater vents and drains C. Feed water piping	272,600	272,600	122,600	254,400
D. Condensate piping 1. From condensate pumps through L-P heaters. 2. To deaerator and B.F.	208,800	188,000	188,000	
pump suctionj E. Main steam	62,400	62,400	62,400	62,400
3. Demineralizing Equipment and Condensate Storage Tanks	388,000	374,000	366,000	348,000
9. Electrical	324,000	319,600	320,000	266,600
O. Turbine Room Building	309,000	309,000	309,000	309,000
Total Items 1-10	42,460,900	42,220,900	41,949,600	41,856,300
Total Constant Cost	12,676,000	12,676,000	12,676,000	12,676,000
Total Turbine Plant Cost	55,136,900	54,896,900	54,625,600	54,532,300
l, Piping In Containment Vessel	752,100	752,100	610,800	610,800 55 1/3 100
Grand Total	55,889,000	55,649,000	55,236,400	55,143,100

SUMMARY OF COST DATA
400 PSIA, 845 F THROTTLE STEAM
(400 F SUPERHEAT)
1000 MWW INDIRECT CYCLE TURBINE PLANT

	1000 MWe INDIRECT OFFE			2	
Heater Arrangement	4	3	27.3	80.000	27,380,000 1,080,000
1. Turbine Generator and Accessories A. Turbine generator unit	27,380,000 1,080,000	27,380,000 1,080,000 CONSTANT -	1,0	80,000	560,000
B. Turbine generator erection C. Reserve exciter	560,000	560,000		60,000	
D. Turbine foundation			,	B40,000	3,070,000
2 Condensers	2,720,000	2,760,000			2.6,000
A. Shells and accessories		1,960,000	2,	026,000 35,000	42,000
B. Dry vacuum pumps	1,942,000 38,500	35,000		270,000	496,000
C. Tubes D. Steam jet air equipment	456,000	460,000		-	138,000
9 P-04100	NONE -			400	28,000
F. Deaeration - hot well of		28.000		28,000	·
cond. G. L-P heaters in exhaust stack	56,000				
3. Circulating Water System A. Structures 1. Crib house a. Substructure					986,000
b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay	927,000	932,000		948,000	
4. Seal well 5. Discharge flume 6. Outfall B. Crib house equipment (erected) 1. Traveling screens	222,000	224,500		231,000	247,000
 Screen wash pumps 					
a screen wash piping				1,280,000	1,334,000
4. Chlorination equipment	1,250,000	1,259,000		1,280,000	735,000
5. Chlorine handling C. Circulating water piping	1,250,000	441,000		682,000	411,000
D. Circulating water pumps	654,000	661,000 384,000	!	392,000	47,200
1. Pumps	381,000	44,500	İ	45,300	•
2. Motors	44,200				
3. Brection		130,000		134,000	155,000
4. Feed Water Heaters	300,000	168,000		254,200	
A. L-P closed heaters	152,000 262,400	257,600		254,24	
B. H-P closed heaters C. Descrating heater	202,407	4 400			
n. Insulation	9,400	4,600 19,000		18,800	
1. Closed heaters	19,400	27,	İ		
2. Deaerators	14,000	14,000		55,600	
 E. Structural work 1. For closed heaters 	58,200	56,600		***	
2. For deserators	2-7-		İ	166,000	160,000
	182,000	170,000	ł	188,000	188,000 282,000
 Boiler Feed Pumps A. Pumps and base plates 	188,000	188,000		270,000	26,200
B. Fluid drive	284,000	282,000 27,400		27,000	10,000
C. Motors	28,800	10,400		10,200	•
D. Erection	11,000	,			
E. Foundation for pumps		88,000	:	92,000	
6. Condensate Pumps	114,000 71,400	44,600		46,000 13,400	
A. Pumps	13,600	13,000	:	,	
B. Motors C. Brection	10,000		÷		162,400
• •		378,000	i	228,800	254,400
7. Piping and Insulation A. Extraction steam B. Heater vents and drains	437,000 228,200	228,200	1	122,600	234,400
C. Feed water piping			ĺ	185,000	
D. Condensate piping 1. From condensate pumps	184,400	185,000	į		113,400
through L-P heaters. 2. To deaerator and B.F.	1	113,400		113,400	
pump suction —	113,400			326,000	328,000
E. Main steam	344,000	334,000		220,	
e nomineralizing Equipment	-,.,		- 1	296,800	248,400
and Condensate Storage Tanks	300,000	296,400	!	309,000	309,000
9. Electrical	309,000	309,000		40,654,100	40,967,00
10. Turbine Room Building	41,334,900	41,085,200	- 1	12,676,000	12,676,00
Total Items 1-10	12,676,000	12,676,000	İ	53,330,100	53,643,00
Total Items 1-10 Total Constant Cost	54,010,900	53,761,200	i	858,600	858,60
Total Turbine Plant Cost	1,071,600	861,600	!	54,188,700	54,501,60
11. Piping In Containment Vessel Grand Total	55,082,500	54,622,800		·	

SUMMARY OF COST DATA
400 PSIA, 945 F THROTTLE STEAM
(500 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	4	3		2	1
. Turbine Generator and Accessories				•	
A. Turbine generator unit	25,620,000	25,620,000		25,620,000	25,620,000
B. Turbine generator erection	1,000,000	1,000,000	CONSTANT	1,000,000	1,000,000
C. Reserve exciter D. Turbine foundation	₹	460,000	COMPTANT	460,000	460,000
. Condensers			į		
A. Shells and accessories	2,550,000	2,584,000		2,660,000	2,868,000
B. Dry vacuum pumps		1,832,000		1,896,000	2,048,000
C. Tubes	1,814,000 38,500	35,000		35,000	42,00
D. Steam jet air equipment B. Brection	430,000	434,000		446,000	474,00
F. Deseration - hot well of	NONE -			`	128,00
cond.	56,000	28,000		28,000	28,00
G. L-P heaters in exhaust stack	50,000	20,000		20,000	
Circulating Water System A. Structures					
1. Crib house					
a. Substructure					
b. Superstructure					
c. Steel	895,000	900,000		915,000	950,00
d. Miscellaneous	0,5,000	,00,000		,,	•
2. Dredging 3. Intake flume or forebay					
4. Seal well			ļ		
5. Discharge flume					
6. Outfall					
B. Crib house equipment (erected)			1		
1. Traveling screens 2. Screen wash pumps	208,000	211,000	i	217,000	233,00
3. Screen wash piping	·	•			
4. Chlorination equipment					
5. Chlorine handling	1,207,000	1,213,000		1,235,000	1,284,00
C. Circulating water piping D. Circulating water pumps					
1. Pumps	610,000	618,000	i	639,000 375,000	688,00 393,00
2. Motors	365,000 42,600	367, 5 00 43,000		43,600	45,50
3. Erection	,_,			-•-	*
Feed Water Heaters A. L-P closed heaters	277,000	123,000		126,000	
B. H-P closed heaters	144,000	158,000	i		146,00
C. Deaerating heater	253,600	248,200		245,600	
D. Insulation	9,000	4,200			
1. Closed heaters 2. Deaerators	18,800	18,200		18,000	
E. Structural work					
 For closed heaters 	14,000	14,000		53,000	
2. For deaerators	55,400	54,000		55,000	
Boiler Feed Pumps	170,000	160,000		156,000	152,0
A. Pumps and base plates B. Fluid drive	160,000	160,000		160,000	160,0
C. Motors	264,000	260,000		248,000	262,0
D. Erection	27,400	26,200	1	25,800	25,2 9,6
E. Foundation for pumps	10,400	10,000		9,800	9,0
Condensate Pumps	107.000	94 000		87,000	
A. Pumps	107,000 66,800	84,000 42,000		43,400	
B. Motors C. Erection	12,800	12,400		12,600	
Piping and Insulation A. Extraction steam	627 000	378,000		228,800	162,4
B. Heater vents and drains	437,000		1		-
C. Feed water piping	228,200	228,200		122,600	254,4
D. Condensate piping			'		
1. From condensate pumps	184,400	185,000	i	185,000	
through L-P heaters. 2. To deaerator and B.F.	,	•		•	
pump suction				**** ***	110 0
E. Main steam	126,200	126,200		118,000	118,0
Demineralizing Equipment	326,000	316,00u		310,000	314,0
and Condensate Storage Tanks	200 200	287 000	1	287,400	239,2
Electrical	290,200	287,000	:	207,400	
Turbine Room Building		38,240,100	1	38,006,600	38,104,3
Total Items 1-10	38,478,300 12,676,000	12,676,000		12,676,000	12,676,0
Total Constant Cost	12,676,000 51,154,300	50,916,100		50,682,600	50,780,3
Total Turbine Plant Cost		1,141,800	i	898,200	898,2
Piping In Containment Vessel	1,141,800	52,057,900		51,580,800	51,678,5
Grand Total	52,296,100				

TABLE 12.8

Coefficients for Turbine Efficiency Calculations

Superheat,					1000 301-
°F	<u>i</u>	1	300 MWe	500 MWe	1000 MWe
0	0	0	1.0404E 01	8.9025E 00	2.1419E 01
v	1	Ö	1.1129E-01	1.4525E-01	-5.5988E-02
	2	0	-5.1301E-04	-7.5757E-04	8.6141E-04
	3	Ö	1.2629E-06	2.1206E-06	-3.8182E-06
	4	Ö	-1.5539E-09	-2.9949E-09	7.1502E-09
	5	Ō	7.4627E-13	1.6532E-12	-4.9023E-12
	ó	1	2.7301E-02	2.4824E-02	8.2673E-03
	ž	ī	1.9444E-08	1.5194年-08	1.6540E-08
	2 3	ī	-2.6711E-11	-1.4429E-11	-1.5388E-11
	ő	2	-2.1767E-05	-1.8738E-05	-1.5549E-06
	Ō	4	8.4504E-12	7.0213E-12	-1.0100E-12
	Ō	5	-3.0096E-15	2.5198E-15	4.3499E-16
	•	_	1.7821E 01	1.3948E 01	1.6967E 01
100	0	0	6.5040E-02	9.4633E-02	1.4907E-01
	Ţ	0	-1.9902E-04	-2.9061E-04	-7.0686E-04
	2	0	3.6786E-07	3.5512E-07	1.9184E-06
	1 2 3 4	0	-3.5274E-10	1.2439E-10	-2.7301E-09
		0	7.3249E-14	-5.2277E-13	1.4835E-12
	5 0		9.4377E-03	1.1772E-02	-5.1442E-04
		1	-5.2080E-09	-1.6490E-08	-9.8009E-09
	2	1	2.0272E-11	4.9757E-11	3.5349E-11
	3 0	1 4	-3.7002E-12	-6.2034E-12	3.9979E-12
			1.7381E-15	3.0865E-15	-2.1251E-15
	0	5	1.12016-13	J.000 L 29	_,,
200	0	0	1.0676E 01	1.1832E 01	5.7998E 00
200	ì	Ö	1.3558E-01	1.3921E-01	1.6956 E- 01
	2	Ō	-5.2044E-04	-6.6213E-04	-9.4484E-04
	3	Ō	8.6497E-07	1.8020E-06	3.1676E-06
	4	Ö	-2.7717E-10	-2.5176E-09	-5.6240E-09
	5	0	-5.1574E-13	1.3522E-12	4.0167E-12
	ó	1	2.3363E-02	1.8945E-02	3.2047E-02
	2	1	7.4909E-09	-4.4374E-09	1.7353E-09
	3	1	9.5050E-12	1.6904E-11	-6.7071E-12
	ő	•2	-1.7707E-05	-1.1753E - 05	-2.5532E-05
	0	4	6.7220E-12	3.4819E-12	1.0811E-11
	0	5	-2.4418E-15	-1.1608E-15	-4.0565E-15

TABLE 12.8 (Continued)

Superheat,	<u>1</u>	1	300 MWe	500 MWe	1000 MWe
300	0	0	-1.4070E 01	1.8261E 01	1.2364E 01
	1	0	9.9272E-02	1.2627E-01	2.0583E-01
	2	0	-3.7457E-04	-5.1824E-04	-1.1012E-03
	3 4	0	9.2703E-07	1.29\$3E-06	3.1665E-06
	4	0	-1.2482E-09	-1.6844E-09	-4.5487E-09
	5	0	5.7252E-13	7.2766E-13	2.4909E-12
	0	1	1.0585E-01	1.8449E-03	1.0456E-02
	2 3	l	-2.3193E-08	-3.0401E-08	-2.0408E-09
	3	1	5.7187E-11	7.2605 E- 11	2.4646E-11
	0	2	-8.8416E-05	4.03 36E- 06	-6.8872E-06
	0	4	3.2060E-11	-2.1851E-12	3.4282E-12
	0	5	-1.0829E-14	6.5224E-16	-1.4455E-15
400	0	0	1.6991E 01	1.4464E 01	2.2964E 01
	l	Ō	7.6389E-02	1.1858E-01	1.0767E-01
	2	0	-1.7279E-04	-4.1898E-04	-2.7793E-04
	3	0	1.5587E-07	8.3163E-07	2.3799E-07
	4	0	7.3936E-11	-7.6624E-10	2.9625E-10
	5	0	-2.9397E-13	7.3871E-14	-6.3302E-13
	0	1	1.9180E-02	1.7215E-02	-1.2565E-02
	2 3	1	-2.2174E-08	-2.7321E-08	-3.1434E-08
	3	1	6.2189E-11	7.0304E-11	8.0475E-11
	0	2	-1.3018E-05	-1.01 6 3E-05	1.7783E-05
	0	4	4.9835E-12	3.28 2 5E-12	-7.8457E-12
	0	5	-1.8833E-15	-1.2177E-15	2.6255E-15
500	0	0	-1.6289E 00	3.1763E 01	3.1763E 01
	1	0	2.2070E-01	1.4307E-01	1.4307E-01
	2	0	-1.2967E-03	-5.9349E-04	-5.9349E-04
	3	0	4.5635E-06	1.4003E-06	1.4003E-06
	4	0	-8.3170E-09	-1.5848E-09	-1.5848E-09
	5 0	0	5.6286E-12	4.3468E-13	4.3468E-13
	0	1	6.1721E-02	-6.04\$4E-02	-6.0454E-02
	2	1	-8.1239E-08	-2.08 8 9E-08	-2.0889E-08
	3	1	2.4067E-10	7.3300E-11	7.3300E-11
	0	2	-2.7368E-05	7.2258E-05	7.2258E-05
	0	4	-1.4674E-10	4.2318E-11	4.2318E-11
	0	5	1.5004E-13	-7.6398E-14	-7.6398E-14

TABLE 12.9

Equations for Turbine Cost Calculations

$$R = \Sigma \ a_{ijk} \ t_s^i \ T_f^j \ P_t^k$$

$$R = \Sigma b_{ijk} t^i T_f^j P_t^k$$

 $400 \leqslant P_t \leqslant 1000 psia$

$$F_1 = R \cdot W$$

$$C_s = \Sigma c_{ij} F_1^i P_t^j$$

$$\Delta C_s = \Sigma d_{ij} t_s^i P_t^j$$

$$C_1 = \Sigma e_{ijk} T_f^i t_s^j P_t^k$$

$$C_t = C_1 + C_s + \Delta C_s$$

TABLE 12.10a

Coefficients	for	Turbine	Exhaust	Flow	Calculations,	$a_{i,ik}$
--------------	-----	---------	---------	------	---------------	------------

			1000 < P _t	≼ 1500 psia	
<u>1</u>	<u>j</u>	k	300 MWe	500 MWe	1000 MWe
0	0	0	1.0872E 00	9.1470E-01	5.2228E-01
1	0	0	-6.3556E-05	3.9252E-04	5.5421E-04
2	0	0	-2.66 3 6E-07	-8.0232E-07	-8.3170E-07
3	0	0	0.	0.	0.
0	1	0	-1.4289E-03	-1.0847E -0 ≯	-1.2769E-03
0	2	0	8.8793E-07	4.1142E-07	6.9040E-07
0	3	0	0.	0.	0.
0	0	1	3.9065E-05	1.3074E-04	7.2342E-04
0	0	2	-1.4378E-08	-9.0364E -0 8	-2.8858E-07
0	0	3	0.	0.	0.
1	1	0	8.5400E-07	3.5681E-07	4.0089E-07
1	0	1	8.6662E-08	7.4253E-08	-3.5697E-08
0	1	1	-1.7134E-07	2.3190E-08	-1.6660E-08

TABLE 12.10b

Coefficients for Turbine Exhaust Flow Calculations, bijk

			400 psia ≼ P	t < 1000 psia	
<u>i</u>	<u>j</u>	<u>k</u>	300 MWe	500 MWe	1000 MWe_
0	0	0	1.0737E 00	1.1162E 00	1.1493E 00
1	0	0	4.3288E-05	1.5262E-0#	1.3479E-04
2	0	0	-2.1754E-07	-3.0396E - 07	-3.2886E-07
3	0	0	-0.	-0.	-0.
Ó	1	0	-1.2006E-03	-1.1892E-03	-1.3524E-03
0	2	0	5.5034E-07	4.3294E-07	6.8091E-07
0	3	0	-0.	-0.	-0.
0	0	1	-5.9594E-07	-1.9225E-0¥	-1.9076E-04
0	0	2	5.2 3 87E-10	5.177 3 E-08	4.7746E-08
0	0	3	-0.	-0.	-0.
1	1	0	6.8856E-07	3.9278E-07	4.4331E-07
1	0	1	2.0068E-07	8.5316E-08	1.0013E-07
0	1	1	-1.5707E-07	9.8612E-08	4.7701E-08

TABLE 12.11

Coefficients	1n	Cost	of	Saturated	Steam	Turbine	Generator, c11

<u>1</u>	1	300 MWe	500_MWe	1000 MWe
0	0	5.9223E 00	1.0890E 01	1.1846E 01
ì	0	7.1604E-01	1.2209E-04	1.2140E-04
2	0	-1.4713E-02	3.6182E-07	4.4817E-07
3	0	-0.	-0.	1 0.
4	0	-0.	-0.	∔ 0.
0	1	3.8569E-04	7.6466E-03	2.1752E-02
1	1	3.8540E-04	-2.2081E-07	1.1026E-07
2	1	-0.	-0.	1 0.
3	1	-0.	-0.	∔ 0.
4	ı	-0.	-0.	∔ 0.
0	2	1.6262E-07	-3.9865E-06	8.7676E-06

TABLE 12.12

Coefficients for the Correction to the Turbine Cost Due to Superheat, dij

1	<u>.1</u>	300 MWe	500 MWe	1000 MWe
0	0	2.1281E 05	-1.7761E 00	8.0147E-01
1	0	-3.8241E 03	-3.4821E-02	5.8779E-03
2	0	8.2770E 00	6.8718E-05	+1.0139E-05
3	0	-0.	-5.9507E-09	2.2179E-08
4	0	-0.	-0.	+0.
0	1	-4.0256E 02	4.4684E-03	+1.971 3 E-03
ı	1	-9.8758E-01	1.5911E-05	2.8293E-05
2	1	-0.	-3.6277E-08	1.4985E-08
3	1	-0.	-0.	+o.
4	1	-0.	-0.	+o.
0	2	1.0355E-01	-2.3139E-06	1.0399E-06
1	2	-0.	1.7544E-09	1.1755E-08

TABLE 12.13

Coefficients for Cost of Turbine Plant Exclusive of Turbine Unit, eijk

1	1	<u>k</u>	300 MWe	500 MWe	1000 MWe
0	0	0	1.1668E 01	1.6537E 01	3.8150E 01
1	0	0	-2.4629E-03	4.0880E~03	-9.4430E-03
2	0	0	0.	-2.3511E-06	-0.
3	0	0	-0.	-0.	-5.5706E-03
0	1	0	-1.3689E-03	-3.0170E-03	0.
0	2	0	4.6191E-06	0.	-0.
0	3	0	-0.	-0.	-2.8624E-02
0	0	1	-8.2634E-04	-5.0569E-03	2.4798E-05
0	0	2	-1.5069E - 06	4.4811E-06	-6.9430E-09
0	0	3	1.5669E-09	-1.2197E-09	-0.
1	1	0	-0.	-0.	-0.
1	0	1	-0.	-0.	-0.
0	1	1	-0.	-0.	-0.
2	1	0	-0.	-0.	-0.
2	0	1	-0.	-0.	-0.
1	2	0	-0.	-0.	-0.
0	2	1	-0.	-0.	-0.
0	1	2	-0.	-0.	-0.
1	0	2	-0.	-0.	-0.

13. Cost Accounting

The over-all energy costs include the charges associated with (1) the capital investment which includes the direct labor and material costs, the direct construction costs, and the D20 inventory charges, (2) the operating expenses which include maintenance, payroll, supplies, D_pO losses, insurance, and organic makeup, and (3) the fuel cycle cost. The charges associated with the capital investment and the operating expenses are determined by the procedure recommended by the AEC and given in the Cost Evaluation Handbook (12). There are two methods available for computing the fuel cycle costs as described in Section 7. The direct labor and material costs are determined from the expressions given in Sections 8, 9, 11, and 12. The schedule of the indirect construction costs are taken from the Cost Evaluation Handbook and include the following charges: general and administrative, miscellaneous, architecture engineering, design and inspection, nuclear engineering, startup, contingencies, and interest during construction. The AEC handbook lists these charges as a function of the direct labor material costs over a range from \$20 to \$200 million. The ratio of the indirect to the direct costs was fitted by the following expression.

$$c_{\rm I}/c_{\rm D} = 0.9567 - 0.01638 c_{\rm D} + 0.2045 \times 10^{-8} c_{\rm D}^2$$

- 0.1096 x 10⁻⁵ $c_{\rm D}^3 + 0.2098 \times 10^{-8} c_{\rm D}^4$

where

 $\mathbf{C}_{\mathbf{I}}$ = indirect construction costs, \$ millions

CD = direct labor and material costs, \$ millions

The fixed charges on depreciable and nondepreciable investment were 14.5 and 13.0% per year, respectively. The charges on D_20 inventory were based on a cost for D_20 of \$20/lb.

The influence of the cost accounting procedures on the optimization of reactor concept can be determined by changing the various charge rates on the library file.

APPENDIX A

INPUT SHEETS

The input sheets for the code are shown in Figures A-I, A-II, and A-III.

The input data required for the automatic fuel design portion of the code follow the control card 8002 and are listed in Figure A-I.

If the "fixed" fuel design option is used, the characteristics of the fuel assembly are listed on the input sheets shown in Figure A-II and follow the control card 8003.

The input cards required for the plant design and cost portion of code are shown in Figure A-III. These data follow control card 8004 for the D_2 0 cooled reactor designs or control card 8006 for the organic cooled designs.

POWER REACTOR COST OPTIMIZATION PROGRAM INPUT DATA FORM - COPIAD

Name*					Phone Date				
8	0	٥	2						
M	٥. ∐	D/	Ϋ́Υ	YR.	RU	N N	0 10	ננ	12 1814 1516 1718 1920 2122 2824 2526 27
<u>B</u>	LOC:	K							<u>OPTION</u>
Lattice geometry: O = square; l = hexagonal Coolant: O = liquid D ₂ O; 2 = organic Cladding: O = Zr; l = SAP Cladding: O = Zr; l = SAP Calandria or liner: O = Zr; l = SAP Insulating annulus: O = inside pressure tube; l = outside Fuel: O = oxide; l = metal; 2 = carbide Number of tubes/assembly Library tape number Einary output tape number								<pre>Iquid D₂O; 2 = organic Zr; 1 = SAP O = Zr; 1 = SAP ner: O = Zr; 1 = SAP lus: O = inside pressure tube; 1 = outside e; 1 = metal; 2 = carbide /assembly n library tape nber</pre>	
			DA	TA	CARI	OS ±	——		Lattice pitch, in.
			_		<u> </u>				Weight of fuel, lb/ft.
		-	-		E				Length of fuel, in.
					I I				Cladding thickness, mils
					I		-		Calandria or liner thickness, mils
Ļ	-			┼	Į Į	_	+-	-	Insulating annulus thickness, mils
					+	3	+-	┼	Inner housing tube thickness, mils
1				-	-	3 .		-	Outer coolant channel OD, in. Only if inner housing
	-				-	Ξ			Outer coolant channel thickness, mils used.
				-	1	3			Fuel density in % theoretical, if oxide
	-		-	+-	1	<u> </u>	-	-	U-235 content in fuel, wt %
2	-			-	 -	<u>≅</u> ∃	-	┼-	Inlet coolant temperature, °C
		_		+	+-+	ુ 3	-		Outlet coolant temperature, °C
	-	_		-	1				Moderator temperature, OC
	•		-	╁	+	E E	+-	+	H ₂ O in moderator, atom %
	┢		+		+ +	E E	╁		Maximum surface temperature, °C
			-+	-	+ +	E E	+	+-	Maximum fuel temperature, °C
		-	-	+	+ +	E E	+	1-	Minimum BOSF
3		-	\dashv	+-	1	E	+	-	System pressure, psia. Only used for organic coolant
_	لعا	L		1	1				1

*Punch 1 Hollerith identification card for each batch of COP problems. 1 in Col. 1.

POWER REACTOR COST OPTIMIZATION PROGRAM INPUT DATA FORM - COPLID Page 1

		Page 1
me*		Phone Date
8	0 0 3	
MO		NO,1011 1213 1415 1617 1819 20 21 22 23 24 25 26 27
COCK		OPTION
10 11	Lattice geom	etry: O=square; l=hexagonal
12	Fuel type: 0	iquid D ₂ 0; l=boiling D ₂ 0; 2=organic =rods; ² l=tubes
L3 L4	Cladding: 0=	Zr; l=SAP
15 16	Calandria or	e: O=Zr; l=SAP Liner: O=Zr; l=SAP
16 17	Insulating a	nnulus: O=inside; l=outside pressure tube
18	Input Diamet	e; l=metal; 2=carbide ers: 0=no; l=yes
19-20 21-22	Number of ro	is or tubes per assembly
23-25		from library tape
26 27	Library tape	
27 D#	TA CARDS ±	t tape number
	E	Pressure tube OD, in.
	E	Outer coolant channel OD, in.
	E	Clad OD, in.
	E	Fuel OD, in. Note: These diameters
	F.	clad OD, in. may be omitted if desired. Block 18 of
	E	Coolant OD, in. the control card must
1	E	Clad OD, in. then be zero.
	E	Fuel OD, in.
	Е	Clad OD, in.
	E	Coolent OD, in.
	E	Clad OD, in; inner housing OD for 2 tubes
	E	Fuel OD, in.
	E	Clad OD, in.
2 .	E	Coolant OD, in.
	E	Inner housing OD, in.
	E	Lattice pitch, in.
	E	Weight of fuel, lb/ft
		Fuel density, % theoretical if oxide
	E	Thei density, & theoretical in think
	E	Length of fuel, in.
	 	

							±		P	OWER REACTOR COST OPTIMIZATION PROGRAM INPUT DATA FORM - COPLID Page 2
						E				Insulating annulus thickness, mils
					<u>L</u>	E				Inner housing thickness, mils; O for no housing
				_	<u> </u>	E		:		Cladding thickness, mils
					_	E				Coolant area, sq. in.
						E		•		U-235 content in fuel, weight %
		_Ĺ				Е				Moderator temperature, °C
4	_			_	<u> </u>	Ε			_	H ₂ O in moderator, atom %
					_	Ε				Design pressure, psia
						Ε				Design temperature, °C
		_		<u>L</u>		E				System pressure, psia
						Ε				Inlet coolant temperature, °C
						Ε				Outlet coolant temperature, C
		_		<u> </u>		E				Maximum assembly power, MW
5						E				Power conducted to moderator, MW
	_					E				Maximum assembly flow, gpm at Tin
			\perp	L.		E				Pressure drop across assembly, psi
						E				Maximum subchannel velocity, ft/sec
					L	E				Maximum heat flux, pcu/hr-ft
						E				Maximum surface temperature, °C
					<u> </u>	E				Maximum fuel temperature, °C
6						E				Minimum burnout safety factor
						Ε				Maximum subchannel coolant temperature, °C*
						E				Fuel fabrication cost (if dia. not specified), \$/kg
						E				Eta
						E			_	Epsilon Note: These are hot,
				_		E				Resonance escape probability clean lattice parameters.
						E				Thermal utilization
7	_					E				K infinity
				-		E				Diffusion area, cm ²
					<u> </u>	E				τ, om ²
				1	<u> </u>	E			_	Migration area, cm ²
						E				Buckling, cm ⁻²
				<u>L</u> .		E				$Cell \Sigma_a$, cm^{-1}
				_		E				Disadvantage factor of the fuel
8					<u> </u>	E				Average $\Sigma_{\mathbf{f}}$ of the fuel, \mathbf{cm}^{-1}
					<u> </u>	Ε			L.,	Axial $\phi_{\rm max}/\phi_{\rm avg}({\rm assembly})$
						E				Radial p'_{max}/p'_{avg} (assembly)
9						E	<u> </u>	L.,	L	Maximum integral of kd0 for the fuel, watts/cm
										* For boiling DoO coolant use steam quality, %

POWER REACTOR COST OPTIMIZATION PROGRAM INPUT DATA FORM - COP2 AND COP2OR

Name'	*		Phone	Date
	N	N = 4 - D ₂	O Coolant	
8	0 0		rganic Coolant	
1	2 3 4 5 6	789		The second secon
Block	k		OPTION	
1	Pile	number to h	be designed (1,2,3,or 4)	
2	Fuel	accounting design only	scheme: 0 = AEC; 1 = ot	her; 9 = run through
3-4	0	depren our	, •	
5-7	File	number from ary tape num	n library tape	•
3-4 5-7 8 9	Binar	ry input tar		
٠F	DATA CA	-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1	Axial reflector thicknes	a. in.
-		E	Radial reflector thickne	-
}	• - - - -	_ <u>E</u>	Thermal power in Pile 1,	
}		E	Load factor, fraction	••••
-		E	Control rods, number	
-		E	Safety rods, number	
, -		E	Delta K in control, frac	tt f on
1	•	E	Reactor discharge time,	
ł	•	E	1	mal power for Pile 3, MW
-	-	E	Max. allowable exposure,	
2	•	E	O for turbine plant opti	
**		E	2A; Boiler pressure for	card 2B
	D_O-Cooled S	System		
. [E	Steam temperature, °C	
<u> </u>		E	Feed-water temperature,	o _F
ŀ	•	E	Turbine plant efficiency	
-	*	E	Turbine plant cost, \$	
2A		E	D ₂ O inventory in turbine	plant, lbs
	rganic-Cooled		, ,	
J.		E	Turbine throttle pressur	e, psia
<u> </u>		E	Turbine throttle tempera	
28		E	Feed-water temperature,	
~~~L	<u> </u>			

^{*} Punch 1 Hollerith identification card for each batch of COP problems. 1 in Col. 1.

^{**} Do not insert cards 2A or 2B if this parameter is 0.

#### **BIBLIOGRAPHY**

- 1. J. W. Wade. A Computer Program for Economic Studies of Heavy
  Water Power Reactors. USAEC Report DP-707, E. I. du Pont de
  Nemours & Co., Savannah River Laboratory, Aiken, S. C. (1962).
- 2. The Tripartite Organic Cooled Heavy Water Reactor Meeting, Santa Monica, Calif. June 11-13, 1962, USAEC Report TID-7648 (Pt. 1).
- 3. W. A. Chittenden and G. V. Hoveke. Engineering Evaluation Studies,
  Heavy Water Moderated Power Reactor Plants. USAEC Report SL-1949,
  Sargent & Lundy, Engineers, Chicago, Ill. (1962).
- 4. Engineering Studies, Heavy Water Moderated Power Reactor Plants.
  USAEC Report SL-2008, Sargent & Lundy, Engineers, Chicago, Ill.
  (1963).
- 5. Engineering Evaluation Studies, Heavy Water Moderated Power Reactor Plants. Quarterly Progress Reports, April-June, July-September, October-December 1962. USAEC Report SL-1974-3, Sargent & Lundy, Engineers, Chicago, Ill. (1962).
- 6. Design Study, Heavy Water Moderated Power Reactor Plants. USAEC Report SL-1965, Sargent & Lundy, Engineers, Chicago, Ill., and Nuclear Development Corporation of America, White Plains, N. Y. (1959).
- 7: Part 3, Design Study, Heavy Water Moderated Power Reactor Plants.
  USAEC Report SI-1653, Sargent & Lundy, Engineers, Chicago, Ill.,
  and Nuclear Development Corporation of America, White Plains, N. Y.
  (1959).
- 8. Summary, Parts 1, 2, and 3, Design Study, Heavy Water Moderated Power Reactor Plants. USAEC Report SL-1661, Sargent & Lundy, Engineers, Chicago, Ill., and Nuclear Development Corporation of America, White Plains, N. Y. (1959).
- 9. R. H. J. Gercke, F. C. Silvey, and G. Asanovich. The Properties of Santowax-R (Mixed Terphenyl Isomers as Organic Moderator-Coolant). USAEC Report NAA-SR-Memo-3223, Atomics International Div., North American Aviation, Inc., Canoga Park, Calif. (1959).
- 10. J. C. Jensen. A Computer Program for Fuel Assembly Design. USAEC Report DP-784, E. I. du Pont de Nemours & Co., Savannah River Laboratory, Aiken, S. C. (1962).

- 11. F. E. Driggers. "BSQ An IBM 704 Code to Calculate Heavy Water Lattice Parameters." Heavy Water Lattices, Second Panel Report, Technical Reports Series No. 20, IAEA, Vienna (1963).
- 12. Nuclear Power Plants Cost Evaluation Handbook. USAEC Division of Reactor Development (1961).
- 13. L. Isakoff. Economic Outlook for D₂O Power Reactors. USAEC Report DP-570, E. I. du Pont de Nemours & Co., AED, Wilmington, Del. (1961).
- Organic Cooled Power Reactor Study. 300-MW Power Plant Conceptual Design, Supplementary Studies. USAEC Report TID-8501 (Pt. 2) (Suppl.) Bechtel Corp., San Francisco and Atomics International Div., North American Aviation, Inc., Canoga Park, Calif. (1959).
- 15. Final Safeguards Summary Report for the Piqua Nuclear Power
  Facility. USAEC Report NAA-SR-5608, Atomics International Div.,
  North American Aviation, Inc., Canoga Park, Calif. (1961).
- 16. Organic Cooled Reactor Study. Part 3. Reactor Concept Evaluation.
  USAEC Report TID-8501, Bechtel Corp., San Francisco and Atomics
  International Div., North American Aviation, Inc., Canoga Park,
  Calif. (1959).
- 17. J. R. Dickinson and R. F. Scarth. OCDR Power Plant Study.
  Report NAA-SR-5688, pp. 275-306, Canadian General Electric Co.
  Ltd., Toronto (1960).
- 18. L. Isakoff and R. R. Hood. Heavy Water Moderated Power Reactors
  Progress Report November 1962. USAEC Report DP-805, E. I. du
  Pont de Nemours & Co., AED, Wilmington, Del. (1962).

## EXTERNAL RELEASE OF TECHNICAL INFORMATION

Description of Material	No.	DP-1007		Date:	5/12/66
Title: A Computer Program for D ₂ O Reactors	or the	Optimizatio	n of O	rganic-	Cooled
Author: J. W. Wade					
Type of Material					
Classified DP Report	7	Classified	Paper		7
Unclassified DP Report $\sqrt{x}$	7	Unclassifie	d Pape	r _	7
Letter	7				
Technical Content					
Approved by /s/ G	. Dess	auer	_Date:	9/14/	65
Classification			and the state of		
Approved by Sul	Ru		_Date:	5/17	-166
Authority:	, orne	aı			
Topic 800 SROO Class	ificat	ion Guide			
Category if DP Report					
Approved by S. W.	Ru	r	Date:_	5/12	166
Final Du Pont Release	- Rec		1 1		
Approved by Coordinating Organ	112/11	on Director	Date:_	5/24/	166
Released by					
R. G. Erdley: 5/17/6	6				

DON'T SAY IT - WRITE IT We now have all the releases on DP-1007 (michighing the one from Sayert and Lundy). I have marked the changes Wade requested and also had Marilea give it a quick book for evers. The yellow marks are hers. you may want to improve some of the equations. I did not fut in Rint Shop because they some sunning DP 1066 this couls. Preventive Safety - Prevents Injuries

<b>s</b> e	DON'I SAY II-WRITE II	de: G. Dessaner
Elise Norton	Location TIS - Savannah	River Laboratory
.W. Wade L.W.W.	Location <u>D-6033</u>	Phone No. 5865
"Release of DP - 100	77 "	Date 6/24/66

Attached is a letter from Bill Chittenden of S & L, giving his comments on DP-1007. I think we should eliminate the S & L title blocks as he suggests and then release the report.

JWW/jws

Enclosure

HELP RESCUE SAFETY-ACCIDENTS ARE KILLING IT

10-62

DON'T SAY IT - WRITE IT Elise DP- 1007 Wade requests that you not issue exteend copies antil a release letter is received from Chillington. Wade has no changes. Chittenden. Preventive Safety - Prevents Injuries

PARTNERS

T.V.SMITH
T.W.HAMMING
T.J.STANKIEWICZ
T.G.NORELL
T.W.MCCLOSKA
J.J.WALSH
W.R.STEUR
R.W.PATTERSON
T.E.ACKMANN

R.N.BERGSTROM

W.A.CHITTENDEN

A.N.ELIASEN

r. D. KOLFLAT

1.ZAR

SARGENT & LUNDY ENGINEERS

FOUNDED BY FREDERICK SARGENT-1891
140 SOUTH DEARBORN STREET
CHICAGO, ILLINOIS 60603
TELEPHONE - FRANKLIN 2-7130
CABLE ADDRESS - SARLUN-CHICAGO

ASSOCIATES

J. R. ARENA R. L. BOYD R.E.DALE J. A. DONALD E.H. FINCH R.I. GAVIN G. F. HOVEKE L.B. LEVESCONTE E.G. MAGNUSON S. MAYSTER D. C. McCLINTOCK J. N. ROLSTON R.K.ROWE R.F. SCHEIBEL L.SKOG.JR. E.J. WOLNIAK

June 14, 1966

Mr. J.W. Wade, Research Manager Applied Mathematics Division E.I. du Pont de Nemours & Company, Inc. Aiken, South Carolina 29801

Dear Mr. Wade:

We wish to acknowledge receipt of a draft of DP-1007 "A Computer Program for the Optimization of Organic Cooled D20 Reactors. We appreciate the opportunity of reviewing this draft and wish to advise that we concur in the material, as presented, and have no comments to offer as such. Unless there is a strong desire on your part to attach the Sargent & Lundy title block to the arrangement drawings included in the report, it would seem to us that these title blocks may be appropriately deleted as they do not really add to the presentation of the material and you have been more than generous in crediting Sargent & Lundy in other ways.

If we can be of any further assistance in this matter, please feel free to contact us.

Very truly yours,

SARGENT & LUNDY

BY Wallitte

WAChittenden: as cc: H.B. Rahner



# DP REPORT PROCESSING FORM (Perform last item checked)

ATION:	DATE: April 1966
PRINC SHOP:	Editor Eliza Date 4/14/6
legroduce Copies 15 Blackline, Pages	
The ment that lett	
	ribution
Send to Editing: Approval copy of report	The same with the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the
Transmittal Letter	
Preliminary Distributio	n
*Mictocopy Transmittal Letter Master	
nis Form	Date to Editing 5/12/66
	A single company of state of the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and the same and th
editing:	
Review Approval Copy and prepare Documen	TO 5/12 FROM 5//L
Send Approval Copy, Release Forms, and t	
The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s	
PRINT SHOP AND DOCUMENT SECTION:	
	Editor Eliki Date 5/16/61
한쪽(K) [14] 전 1 전 1 전 1 전 1 전 1 전 1 전 1 전 1 전 1 전	
Bind and issue IS Preliminary (blace	Wine) Copies
5 alpho 500 - Sweet for	kline) Copies  Late of Preliminary Issue 5///
Bind and issue 15 Preliminary (black 3 Capus to TNW - Sugartan Send Blackline Record Copy with this For	kline) Copies  Late of Preliminary Issue 5///
Send Blackline Record Copy with this For	ckline) Copies  Date of Preliminary Issue 5//1  m to Editing. Date to Editing 5//7
Send Blackline Record Copy with this For	kline) Copies  Late of Preliminary Issue 5///
Send Blackline Record Copy with this For DITING: Collect corrections and releases. SAM: Send corrected Blackline Record Copy. Co	Skline) Copies  Late of Preliminary Issue 5//L  The to Editing. Date to Editing 5//7  Skyll (AEC 5/17/44 Author 6/8/46 SWO'R 5/12/44)  FHS 7/8/64  Orrected photocopy, Internal
Send Blackline Record Copy with this For	Skline) Copies  Late of Preliminary Issue 5//L  The to Editing. Date to Editing 5//7  Skyll (AEC 5/17/44 Author 6/8/46 SWO'R 5/12/44)  FHS 7/8/64  Orrected photocopy, Internal
Send Blackline Record Copy with this For DITING: Collect corrections and releases. SAM: Send corrected Blackline Record Copy, co	Shift (AEC 5/17/44 Author 6/1/45 WO'R 5/12/44 FHS 7/8/64 Orrected photocopy, Internal Master, and this Form to Print Shop
Send Blackline Record Copy with this For DITING: Collect corrections and releases. SAM: Send corrected Blackline Record Copy, co Distribution Master, Transmittal Letter RINT SHOP: Decklere	Date of Preliminary Issue_5//( m to Editing. Date to Editing_5///  Space AEC 5/17/66 Author 6/2/16/2000 R 5/2/1/  FHS 7/8/66  Prected photocopy, Internal Master, and this Form to Print Shop
Send Blackline Record Copy with this For DITING: Collect corrections and releases. SAM: Send corrected Blackline Record Copy, co Distribution Master, Transmittal Letter RINT SHOP: See Blackline	Date of Preliminary Issue 5//1  The to Editing. Date to Editing 5//2  SAME AEC 5/17/16 Author 6/2/16 SWO'R 5/12/16  PHS 7/8/166  Prected photocopy, Internal  Master, and this Form to Print Shop  Editor Date 7/20/6  Preport, Pages Price 6
Send Blackline Record Copy with this For DITING: Collect corrections and releases. SAM: Send corrected Blackline Record Copy, con Distribution Master, Transmittal Letter RINT SHOP: Metablem Take corrections and print copies 435	Editor Date Date 7/20/6  Editor Date Date 7/20/6  Editor Date Date 7/20/6  Transmittal Letter
Send Blackline Record Copy with this For DITING: Collect corrections and releases. SAM: Send corrected Blackline Record Copy, con Distribution Master, Transmittal Letter RINT SHOP: Dischere Take corrections and print copies 430	Date of Preliminary Issue 5//1  The to Editing. Date to Editing 5//2  SAME AEC 5/17/16 Author 6/2/16 SWO'R 5/12/16  PHS 7/8/166  Prected photocopy, Internal  Master, and this Form to Print Shop  Editor Date 7/20/6  Preport, Pages Price 6
Send Blackline Record Copy with this For DITING: Collect corrections and releases. SAM: Send corrected Blackline Record Copy, con Distribution Master, Transmittal Letter RINT SHOP: Late Blackline Take corrections and print copies 435 end to Editing:	Editor Date Date 7/20/6  Editor Date Date 7/20/6  Editor Date Date 7/20/6  Transmittal Letter
Send Blackline Record Copy with this For DITING: Collect corrections and releases. SAM: Send corrected Blackline Record Copy, con Distribution Master, Transmittal Letter RINT SHOP: Dischere Take corrections and print copies 430	Editor Date Date 7/20/6  Editor Date Date 7/20/6  Editor Date Date 7/20/6  Transmittal Letter
Send Blackline Record Copy with this For DITING: Collect corrections and releases. SAM: Send corrected Blackline Record Copy, condition Master, Transmittal Letter RINT SHOP: Lake corrections and print copies 435 end to Editing: Approval copy of report	Editor Date Date 7/20/6  Editor Date Date 7/20/6  Editor Date Date 7/20/6  Transmittal Letter
Send Blackline Record Copy with this For  DITING: Collect corrections and releases. SAM: Send corrected Blackline Record Copy, co Distribution Master, Transmittal Letter  RINT SHOP: Lake corrections and print copies 435  end to Editing: Approval copy of report Transmittal Letter.	Editor Date Date 7/20/6  Editor Date Date 7/20/6  Editor Date Date 7/20/6  Transmittal Letter

Re Fo	eview printed Record Copy. Returnments and this Form to Print Shop	m printed Record Copy with Publication
Bind IN Se: EX TO Se:	and issue report: TERNAL DISTRIBUTION Copies THERNAL DISTRIBUTION Copies THERNAL DISTRIBUTION Copies TAL copies and Record Copy, External Distribution to Editing.	Editor Para Date 9/2  23 with TL  57 without TL( 7 SROO Suppl 50 Spc  15/25 without TL (TIS FILE)  105 and 3 extra copies of TL  330 without TL  435 of report oution List, and this  Int. Issue Date 9-26-66  Ext. Issue Date 9-16-66  Date to Editing 9/26/66
	File Record Copy  Report Data Sheet  Document Review  Request for Patent Review  Transmittal Letter  Preliminary Distribution  TID Distribution	
	2 copies (5 W. A. SARGEA	Chittonden 17 L Lungy



#### E. I. DU PONT DE NEMOURS & COMPANY INCORPORATED

SAVANNAH RIVER LABORATORY AIKEN, SOUTH CAROLINA 29802

(TWX: 803-824-0018, TEL: 803-824-6331, WU: AUGUSTA, GA.)

Mr. R. G. Erdley, Chief Patent Branch Savannah River Operations Office U. S. Atomic Energy Commission Post Office Box A Aiken, South Carolina

Dear Mr. Erdley:

CC: L. C. Evans - C. W. J. Wende -J. W. Croach

S. A. McNeight

W. P. Overbeck - G. Dessauer -TIS File

May 12, 1966

#### REQUEST FOR PATENT REVIEW

Please review for patent matter:

DP-1007, A Computer Program for the Optimization of Organic-Cooled DO Reactors, by J. W. Wade

If any technical clarification is needed please call J. E. Beach whose document review is attached.

Please telephone your comments to the TIS Office (Ext. 3402) and notify me by signing and returning to TIS the original of this letter. A copy is provided for your file.

If you decide to pursue a patent on any development covered, I shall be happy to supply additional information required such as appropriate references and the names of persons responsible for the development.

The above item is approved for release.

Very truly yours,

R. G. Erdley, hief Patent Branch

SROO, USAEC

C. W. J. Wende, Director Technical Division

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

#### TECHNICAL DIVISION SAVANNAH RIVER LABORATORY

MEMORANDUM

TO:

S. W. O'REAR

FROM:

J. E. BEACH

DOCUMENT REVIEW

Document:

Report DP-1007

Title:

A Computer Program for the Optimization of Organic-Cooled D2O Reactors

J. W. Wade

Author:

Contractual Origin: AT(07-2)-1

Present Classification:

Unclassified

References:

No items were noted that, in my opinion, should be called to the attention of the AEC for patent consideration.

Form AEC-426(7-64)
AEC Manual Chapter 3202, Appendix 064a

## UNITED STATES ATOMIC ENERGY COMMISSION PUBLICATION RELEASE FORM

Document Number

DP-1007

INSTRUCTIONS: This form should accompany each UNCLASSIFIED document the first time it is submitted to the USAEC Division of Technical Information Extension, Post Office Box 62, Oak Ridge, Tennessee 37830.

A Computer Program for the Optimizati	Date of Document	<b>April</b> 1966
Author(s) W. Made	Contract No.	AT(07-2)-1
Research and Development Report Enclosed is a TID-4500  AEC Manual Chapter 3202. No Journal Publication or Ord II or III below if Journal Publication is Intended or Section  1. Complete TID-4500 distribution has been made, including copies Information, National Bureau of Standards (formerly OTS) (Federal copies specified in TID-4500 has been forwarded to the Division of further distribution to domestic and foreign depository libraries, for in Nuclear Science Abstracts.  2. Document has been printed but complete TID-4500 distribution in Division of Technical Information Extension to:  a. Make complete TID-4500 distribution including copies to It itory libraries, etc.  b. Make distribution to Federal Clearinghouse and depository distribution has been made in accordance with TID-4500 (Ic. Other. Please specify  3. No copies have been printed for TID-4500 and Federal Clearinghouse and make TID-4500 distribution, including copies to Federal Clearinghouse is:  a. Printed copy  (Up to 25 copies will be furnished to authors if desired. Indicate is DTI may reproduce from their master copy and make TID-4500 of for public sale, and to depository libraries, etc.  (Up to 25 copies will be furnished to authors if desired. Indicate is the popular produce from their master copy and make TID-4500 of for public sale, and to depository libraries, etc.	al Presentation is Into IV if Oral Presentation IV if Oral Presentation is Into IV if Oral Presentation of Clearinghouse sale price of Technical Information oreign exchange organizations not been made. Copies Federal Clearinghouse (salibraries, etc. AEC and of Federal Clearinghouse salibraries, etc. AEC and of Federal Clearinghouse salibraries, etc. AEC and of Federal Clearinghouse salibraries for public sale c. Reproduction Reproduction including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communication including communicat	ended. (Use Section ation is Intended.)  Federal Scientific and Technical exis \$
II. Document Enclosed is a TID-4500 Standard Distribution Re Publication:	eport which is also ir	tended for Journal
<ol> <li>TID-4500 (AEC) distribution has been made. Copies are enclosed Clearinghouse and to the domestic depository libraries, and for an 2. Copies are being furnished DTI to make TID-4500 (AEC) distribution and to the domestic depository libraries, and for announcement in 3. From the copy enclosed, DTI is requested to reproduce in Microc depository library distribution and send 1 full size copy to Federal Document enclosed has or will be submitted for publication in the follows:</li> </ol>	nnouncement in NSA.  tion, and single copy district  NSA.  ard form and make TID-4  Clearinghouse, and anno	ribution to Federal Clearinghouse
(Name of Journal)	(Expected date of issu	ance)
<ul> <li>Document enclosed is intended for publication in a journed distribution within the AEC and single copy distribution to pository libraries.</li> <li>Paper has been or will be submitted for publication in the following science.</li> </ul>	o Federal Clearingho	policy precludes advance ouse and to domestic de-
(Name of Journal)	(Expected date of Issuance	e)
(NOTE: DTI will hold this document for internal use and will not announce unique circumstances when the report is required by present work of anothe in the journal. Such further distribution by DTI will be limited to specific	r AEC Contractor in adva	ace of the paper's appearance

Name, Location, Sponsor of Mee	ting	Date
ublication plans are:		
. This paper will be included in the published proceed	lings of the meeting.	
. This paper will not be included in published proceed	lings. After the date indicated	
a. DTI is requested to reproduce and make TID-	4500 distribution, including co	ppies to Federal Clearinghouse, depository
libraries and announce in NSA.		NOT THE TOTAL TOTAL
<ul> <li>b. We (originator) will make TID-4500 distributing please transmit copies to DTI with a new PRF</li> </ul>		
c. Paper will be submitted for journal publication		
submit to DTI a new PRF appropriately check		
Document enclosed is an internal or inform	nal report not intended fo	or TID–4500 Standard Distribution,
Journal Publication or Oral Presentation.	'	•
EC Manual Chapter 3202 requires that informal reports ge	enerally be given TID-4500 dis	stribution, and that technical information
ontained in internal reports also appear in a distributable	document which receives appr	opriate distribution.
hapter 3202 does recognize that issuing organizations may		
nternal reports (subsequently distributed externally) under- riginator, or DTI and the cognizant AEC Program Division	·-	
o Federal Clearinghouse.	if distribution limitations spec	cined by the originator appear questionaut
Recommendations are:		
1. DTI is is not to make selected positive distribu	ution to certain AEC contracto	rs as appropriate.
2. DTI is is not to fill requests for this document		
3. DTI is is not to selectively distribute and fill r		
4. DTI is is not to make a single copy available	to rederal Clearinghouse and a	announce in NSA.
IF DISTRIBUTION LIMITATIONS ARE INDICATED ABOV	VE, LIST JUSTIFICATION OR	REASONS AS REQUIRED BY AEC MANUA
CHAPTER 3202.		
,		
		O
atent clearance for the document cited in this	Publication Release Forn	n has 🛂 has not 🔲 been obtained.
		$\Omega = (X)$
		/// 6//\0 .
	This release is sub	omitted by:
		(signature)
		F. H. Springer
	•	(name typed)
		vannah River Laborator
	Organization Sa	
	Organization <b>Sa</b>	9/1/1
	Organization Sa	9/7/66

and the second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second s

_____

## REPORT DATA SHEET

### TECHNICAL DIVISION SAVANNAH RIVER LABORATORY

HSH Wys.

hort Number	DP-1007	s cyul	ipproved by	
thor(s)	J. W. Wade			
tenor (b)				to Cooled
	A Computer Progra	m for the Opti	imization of Organ	16-600164
itle	D ₂ O Reactors			
ivision				
ndicate known	prior art			
			enam Laborato	Thurson 9/17
approval (Intr	oduction, Summary,	Section Dire	ector Laborato	ry Director
Cover Lette	er)	gecozon -		
		Author	Supv.	Div. Hd.
987 10/	<b>ઇ</b>	<del></del>		Male 7-23-4
Manuscript App	oroval (MS) -		<i></i>	
Reproduction (	Copy Approval (RC)			)
ecommended for	or Publication		-	<u>.</u>
	n			
	at			
Legenoavion				
	MO BE	COMPLETED BY	ris	
$\circ$	**************************************		710-4500	45#61
ategory	actor Technology	7-1	1710-4500 High 194/2	V C4
	on of Abstract		194/2	3
lassification	on of Title			
ransmittal	Letter DPTL	•		
of copie	s for Distribution	Ap	proved by	
			Total Pages	
<b>™™-4500</b>		معراه وبدوه وبيدو والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود والمراود وال	Price	
m-3679				
Special				800
AECL				
TOTATI				

#### INTERNAL DISTRIBUTION

Copy No.		
1-7.	P. J. Hagelston	SROO, Aiken, S. C.
8.	H. F. Carroll	Declassification Branch USAEC, Oak Ridge, Tenn.
10. 11. 12.		Wilmington AED " " " " " " " "
15.	A. E. Daking	Engineering Department
17.	J. A. Monier - K. W. French W. P. Bebbington L. W. Fox	Savannah River Plant " "
20. 21. 22. 23. 24. 25. 26. 27. 28.	W. P. Overbeck - A. A. Johnson J. O. Morrison J. E. Beach G. Dessauer P. L. Roggenkamp J. L. Crandall J. W. Morris E. C. Nelson J. E. Suich L. M. Arnett J. C. Jensen TIS File Record Copy	Savannah River Laboratory  ""  ""  ""  ""  ""  ""  ""  ""  ""

#### PRELIMINARY DISTRIBUTION

## Copy

- 1. R. L. Morgan
- 2. I. A. Hobbs
- 3. R. G. Erdley
- 4. S. A. McNeight
- 5. L. C. Evans C. W. J. Wende -
  - J. W. Croach
- 6. D. F. Babcock
- 7. L. W. Fox
- 8. W. P. Overbeck A. A. Johnson J. O. Morrison
- 9. G. Dessauer
- 10. P. L. Roggenkamp
- 11. J. L. Crandall
- 12-14. J. W. Wade

1. gold 1. gold 1. gold . TIS File Record Copy

SROO, Aiken, S. C.

tt

..

Wilmington AED

Ħ

Ħ

Savannah River Plant

Savannah River Laboratory

11

11 11

11

11

Miller N. Hudson, Jr. USAEC Scientific Representative Chalk River Liaison Office

W. M. Vannoy
The Babcock and Wilcox Co.

H. T. Babb Carolinas Virginia Nuclear Power Associates, Inc.

Dr. Manson Benedict MIT

D. A. Douglas ØRNL - Union Carbide Corporation

Milton Shaw USAEC Div. of Reactor Dev. and Tech.

A. N. Tardiff USAEC Div. of Reactor Dev. and Tech.

I. F. Zartman USAEC Div. of Reactor Dev. and Tech.

R. L. Morgan RDT - Canoga Park

A. J. Alexander RDT - Windsor, Conn.

C. Starr
Atomics International

S. Visner Combustion Engineering, Inc.

C. L. Storrs HWOCR Program Office Atomics International

R. H. Vollmer HWOCR Program Office Atomics International

D. S. St. John, Wilm. H. J. Kamack, Wilm. J. S. Neill, Wilm.

J. G. Melvin address not localed

J. H. Kruth, SROO

returned 10/12/66 miles with recons